Vol. 2

BULLETINS
OF
AMERICAN PALEONTOLOGY

—:o:—

No. 9

THE LIGNITIC STAGE

PART I

STRATIGRAPHY AND PELECYPODA

BY

G. D. Harris

June 15, 1897

Ithaca, N. Y.
U. S. A.

THE LIGNITIC STAGE.

BY

Gilbert D. Harris.

PART I.

STRATIGRAPY and PALEONTOLOGY (PELECYPODA.)

SUMMARY OF CONTENTS.

PRELIMINARY CONSIDERATIONS.

Page.

Divisions of the Lignitic.......................... 4

Aim and scope of this work.................... 5

Collection of fossils, field notes etc., on which this work is based: *The Cornell University expedition of 1895; the Cornell University expedition of 1896; T. H. Aldrich's collections of fossils and drawings; the authors works and field notes on this stage in Arkansas and Alabama*.......... 5–6

SECTION I. STRATIGRAPHY...................... 6–36

Texas: *Rio Grande, Colorado River, Brazos River, East of Brazos River*............................... 6–10

Louisiana........ 10
Arkansas: *Geology about Camden*........ 10–12
Missouri........ 13
Illinois........ 13–14
Kentucky........ 14–16
Tennessee........ 16–17
Mississippi........ 17–18
Alabama........ 18–32
Georgia........ 32–33
List of stratigraphic terms that have been applied to part or all of the Lignitic stage........ 226–228
SECTION II. PALEONTOLOGY (PELECYPODA........ 34–74
EXPLANATION OF PLATES........ 75–102

———:O:———

PRELIMINARY CONSIDERATIONS.

Divisions of the Lignitic.

The larger subdivisions or stages of the Eocene series have already been given on page 118, vol. 1, Bull. Amer. Paleont. The second of these stages, the Lignitic, may be conveniently subdivided as follows:

LIGNITIC.	Bashi.	Hatchetigbee. Woods Bluff.
	Bell's Landing.	Bell's and Gregg's Landings. Nanafalia.

* * * * *

Aim and scope of this work.

Bulletin No. 4 was devoted to the statigraphy and paleontology of the lowest or Midway stage of the Eocene as developed in the Mississippi basin. This bulletin treats of the Lignitic as developed in the same basin. Time, however, has prevented a discussion of the univalves in this part of the work, but they will be taken up at once with the resumption of laboratory work in the fall.

Little need here be said regarding the general aim and purpose of this work, for it is a continuation of Bulletin No. 4. (See Bull. Am. Pal., vol. 1, p. 119.)

Collections of fossils, field notes, etc., on which this work is based.

The Cornell University Expedition of 1895.—A brief account of this expedition was given in Bull. 4, p. 5, and it remains here only to say that while the Midway stage was the special subject of study during 1895, frequent detours were made into nearby Cretaceous as well as Lignitic or even higher beds. The following fossiliferous Lignitic outcrops were visited: Nanafalia, Tuscahoma and Woods bluff on the Tombigbee and Ft. Gaines on the Chattahoochee.

The Cornell University Expedition of 1896.—In the spring of this year the Trustees of Cornell University generously repeated the appropriation of 1895, thus enabling Mr. W. S. Hubbard and the writer to again visit the Gulf and Atlantic States. The Lignitic outcrops of note in Alabama were examined from the Tombigbee on the west, to near Ft. Gaines on the east. The Midway beds at Black bluff were examined, and the line of nonconformability between the Cretaceous and basal Eocene not far south of Moscow Ferry was thoroughly explored. The well known *Enclimatoceras ulrichi* and *Ostrea pulaskensis* were found here as elsewhere just above the nonconformability. Better fossils were moreover obtained from a bluff opposite to and about ⅓ mile below Matthew's Landing on the Alabama. More perfect specimens of several species described from Clayton were also obtained.

Detours were made to the south of the Lignitic belt, including one as far as Jackson on the Tombigbee and Claiborne on the Alabama. Midway beds were traced to near Putnam, Ga., and the extensive northern overlapping of the Vicksburg throughout that State was noted. (See Am. Geol., vol. 18, p. 236.) A large collection was made from the classical old Shell bluff on the Savannah. Later on, in the latter part of August, collections were made from Eocene and Miocene exposures along James, Rappahannock and Potomac rivers in Virginia and Maryland, a region that will be thoroughly investigated during the present summer.

T. H. Aldrich's collection of fossils and drawings.— Mr. Aldrich has very kindly lent the greater part of his type collection of Lignitic mollusca for inspection during the preparation of this work. These as well as the drawings used in Bulletin 8 have been of great service.

The author's works and field notes on this stage in Arkansas and Alabama. — Many detailed sections of Lignitic exposures in Arkansas are given by the author in vol. 2, of the annual report of the Geological Survey of that State for 1892; but no zoogene fossils were found. In 1893-94 he twice visited some of the famous Alabama exposures, once while in the employ of the State Survey of Texas and once while in quest of fossils for his own cabinet. These together with his English and Paris basin fossils have been very serviceable during the preparation of this work.

SECTION I. STRATIGRAPHY.

Texas.

References: — *First Ann'l. Rept. Geol. Survey Tex., 1889, p. 22, et seq.,—Penrose. Geological Survey of Texas, Report on the Brown Coal and Lignite of Texas, 1892, p. 130 et seq.,—Dumble. 2d Ann'l. Rept. Geol. Sur. Tex., 1891, p. 50 et seq.,—Kennedy.*

But little is definitely known regarding the Lignitic beds of Texas. Penrose was the first to study them with any degree of care. Owing however to the lack of molluscuous remains throughout nearly their whole extent, it is impossible to accurately define them geographically or stratigraphically. Below is a brief summary of our present knowledge on the subject.

Rio Grande.—It is possible that beds belonging to the Lignitic stage will be found along the Rio Grande; but at present there is no proof that such beds exist; on the contrary, if the expansion of the Lower Claiborne in this part of the State is, as it would seem to be from the meagre data we have, it is quite probable that it overlaps the Lignitic and Midway stages and meets the Cretaceous.

Colorado River. — On this river the Lignitic beds must be very poorly represented, for Penrose writes that five miles by river below the outcrops of the Basal clays in the neighborhood of Webberville, a low fossiliferous bluff is seen. These fossils identified by the present writer, are of Lower Claiborne horizon. Hence the Lignitic deposits can have on this river a width of no more than five miles.

Brazos River. — It is on the Brazos River where the Lignitic stage is typically exhibited. Penrose thus describes this section: *

"About a mile and a half below Pond creek is seen an outcrop of Tertiary sand, containing black specks and rendered plastic by a white clay. It is capped by semi-indurated Quaternary gravel and sand, and contains large nodules which give a strong reaction for carbonate of lime, and which are simply hardened masses of the enveloping sand. They are one to eight feet in diameter, hard, kidney-shaped, flat or nodular, and project out of the compact sandy bluff in a most characteristic manner. Loose fragments of silicified wood, which have also doubtless been derived from the same bed, lie among the many nodules that have been eroded out. So many of these rocky masses have been loosened from the sand and piled up in the bed of the river that they have obstructed its course, and have formed rapids. Many of these rocks are round or oval, and are locally known as "kettle bottoms." Such strata as these are seen down the river for a mile and a half from this point, where they dip under a series of gray clays containing beds of lignite, varying from one to five feet thick and associated with ferruginous sand. The clay contains large masses of silicified wood, which is sometimes seen in places in the bed, but more often has been weathered out and lies in the bed of the stream. Occasionally nodules of clay ironstone, generally in a semi-oxidized condition, are found. Such strata are exposed for about a mile, when the gray sands with calcareous concretions and indurations again appear. This deposit contains considerable quantities of iron pyrites, and the indurations are often cut by veins of crystalline calcite. A short distance below here is Calvert Bluff,* Robertson county, where lignite occurs in large quantities and has been worked intermittently for many years. The beds of this strata are shown in the following section:

---

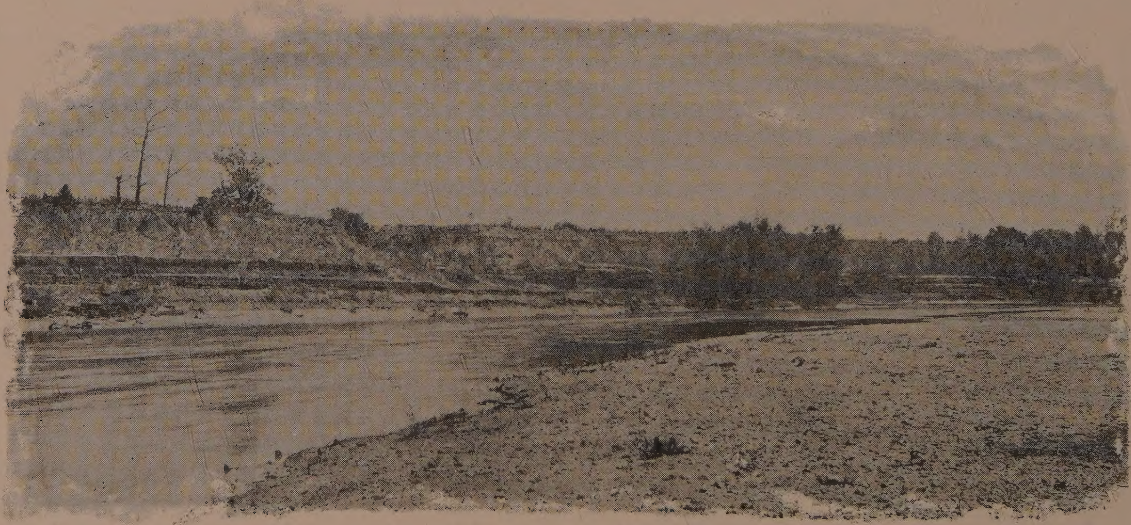
* 1st Ann'l. Rept. Geol. Sur. Tex., 1890, p. 26.

1.	Brown and red river silt	10 feet
2.	Gray clay	0 to 3 feet
3.	Lignite	12 feet
4.	Gray clay	2 feet
5.	Lignite	2 feet
6.	Gray clay	3 feet

The clay beds in the above section contain large clay ironstone concretions, which enclose many leaf impressions. The lignite is black, woody, friable, and of a dull lustre. It is faulted and much jointed. Dip, three degrees southeast. From here to where the International and Great Northern Railroad crosses the river we see sand beds with calcareous indurations, such as have been described at Rocky Rapids. At this point is a bluff showing sixteen feet of Tertiary strata, capped by over fifteen feet of a highly calcareous light green and yellow Quaternary clay containing many small white concretions. The base of the Tertiary part of this bluff is composed of black clay from the water edge up to ten feet above it, and is overlaid by six feet of non-fossiliferous greensand marl. The Quaternary lies unconformably on the Tertiary strata. It is to be seen at many points along the river from Falls county down, and is doubtless the representative of an old river silt formation. For twelve miles below this point is seen a series of interbedded and interlaminated clays and sands, with occasional beds of lignite, and some few small gray calcareous concretions. Frequently small fragments of lignite are seen in the sand beds, showing that the swifter waters, which changed the character of the bed from clay to sand, were also responsible for the destruction of lignite beds, the fragments of which were deposited with the sand.

---

* The figure herewith given is from State Geologist Dumble's work on the Lignite or Brown Coal of Texas.



CALVERT BLUFF; a Lignitic outcrop on Brazos river, Tex.

East of Brazos River.— Lignite deposits are known to increase rapidly in areal extent eastward from the Brazos, but so far as we are aware there are no sections better adapted for study than the one just cited along that river. One thing, however, seems very remarkable, viz, the occurence of fossils on the Sabine river so far down as Sabinetown, that have a lignitic aspect. They were obtained by C. W. Johnson, while collecting for the Lea Memorial Collection. It is certainly strange that in counties to the north, as Cherokee, Rusk and Nacogdoches, in Texas and Bossier and Bienville parishes in Louisiana, typical Lower Claiborne fossils should be found in abundance, while at Sabinetown, this seemingly Lignitic fauna occurs. This is the first Lignitic fauna discovered west of Alabama.

That Lower Claiborne deposits also occur near or at this bluff, is proven by the fossils received by the Geological Survey of Texas, while the writer was one of its employés. They were furnished by Mr. John W. Low, who resides in a neighboring town, and consist of *Venericardia planicosta*, *Levifusus trabeatus*, *Nassa scalata*, *and Pseudoliva vetusta ; Nassa scalata* is so far as known confined to the Lower Claiborne.

There seem to be no grounds whatever for regarding this bluff as of Jackson or "Mansfield" age.

Mr. Johnson has very kindly furnished me with the section at Sabinetown given below. The bluff he estimated to be about 200 feet in length, and to show a southern dip of about 20 feet. He remarks "I got the fossils from the upper portion, where the bluff was not over 35 or 40 feet high. A large spring was pouring over the bank, which probably prevented the fossiliferous strata from becoming sandstone, as it was on the dry portion of the bluff. They were not very plentiful, and it was hard work to find the few I got. I was told that just above the ferry, (probably a half mile above the bluff) was a bed of lignite etc."

Section at Sabinetown, Texas.

1.	Soil	5 feet
2.	Sand, stratified and more or less indurate	25 feet
3.	Laminated sandy clay	12 feet
4.	Yellowish sand with thin layers of iron-stone	3 feet
5.	Grayish sand	7 feet

6.	Hard, fossiliferous sand-stone	3 feet
7.	Indurate sandy clay, fossiliferous	5 feet
8.	Indurate greenish sand, containing one or two strata of sandstone	20 feet
	Total	80 feet

The most characteristic species are: *Calyptraphorus trinodiferus*, *Cornulina armigera*, *Volutilithes petrosus* var. *tuomeyi*, *Corbula*, probably a var. of *alabamiensis*, *Leda aldrichiana*, *Mactra* var. *bistriata*, *Sigaretus bilix*, "*Kellia*" *prima*, *Natica*, *Tellina*, and a large *Cardium* not yet described.

Louisiana.

References: — Report on the Iron Ore Region of La., and Eastern Texas, House Doc. No. 195, 50th Congress, 1st Ses. 1888,—Johnson. Ann'l Rept. Ark. Geol. Sur. 1892, vol. ii, p. 181,—Harris. American Geologist, vol. 15, p. 209, 1895,—Vaughan. Bull. 142, U. S. Geol. Sur. p. 15, 1896,—Vaughan.

The northwestern corner of this State may be occupied by Lignitic deposits as indicated on the map accompanying my report on the Tertiary Geology of Southern Arkansas; vol. ii as given in the references. All molluscan remains of the Lower Claiborne stage seem to die out a few miles north of Plaindealing. These unfossiliferous beds were supposed by me to be the continuation of similar deposits in Arkansas, which I referred to the Lignitic.

Arkansas.

References: — Trans. Amer. Philos. Soc., vol. i, New Ser. 1817, —Maclure. Jour. Acad. Nat. Sci., vol. ii, pp. 45–46,—Nuttall. Carte Géologique des États-unis et des Provinces Anglaises de l' Amérique du nord, 1858,—Marcou. Second Rept. Geol. Reconn. Ark., 1860,—Owen. Jour. Acad. Nat. Sci. 2nd Ser., vol. 9, pl 4,—Heilprin. Ann'l Rept. Geol. Sur. Ark., 1888, vol. ii,—Hill. Ann'l Rept. Geol. Sur. Ark., 1892, vol. i, pp. 105–138,—Penrose. Ann'l Rept. Geol. Sur. Ark., 1892, vol. ii,—Harris.

In my report on the Tertiary of Arkansas, I have referred the greater portion of Grant, Dallas, Ouachita, Nevada, Columbia and Miller counties to the Lignitic stage. This I was induced to do by the presence in many places along the Cretaceous border of thin Midway deposits, and the presence of Lower Claiborne fossils in the northern Bossier, Webster, and Claiborne parishes in Louisana, and at Walnut bluff, Ouachita county, Arkansas. Farther east, in Cleveland and Jefferson counties, the Jackson with possibly some Claiborne beds approaches rapidly the Cretaceous border. It was pointed out that although beds of Lignitic age do exist in Arkansas, between these Midway and Claibornian deposits, exact lines of demarcation cannot be drawn. A general idea of their distribution is indicated by the map accompanying that report. Some of the typical localities on or near the Ouachita were described in Ann'l. Rep't. Geol. Sur. Ark., 1892, vol. ii. The old coal mine spoken of by Owen, on section 12, 12E, 18W, was visited and the following facts noted:

Mr. Richmond Hibbard who resides at that place says it is in the northeast quarter of the above section. The following outcrop is at present visible:

Section at the old mine of the Camden coal company, Ouachita county, Arkansas.

1.	Arenaceous material, not well exposed	
2.	Light pinkish clay	6 feet
3.	White sand	6 feet
4.	Bluish clay	8 feet
5.	Lignite	6 feet

The bed of lignite here represented is unbroken by sand or clay partings, but vertical joints passing in a north-northwest, and south-southeast direction, stained with iron oxide are numerous. Its color is more nearly that of true coal than that of any other lignitic deposit seen by the writer in the State. It is generally dull black, though streaks from one quarter to three quarters of an inch thick, of hard shiny matter are not uncommon.

There is a new opening into this bed, in 12S., 18W., section 14, the northwest quarter of the southeast quarter, which is, according to Mr. Hibbard, very nearly or quite on a level with the old opening. Other outcrops of this bed are said to occur in sections 2, 11 and 13.

The only fossils found in this vicinity by the writer were leaves, or their impressions, in a sandy, indurated, and highly ferruginated matrix. Numerous chunks taken from the new opening were literally packed with scaly, leaf-bearing layers.

The surface of this district is rendered exceedingly rough by the obdurate character of numerous sandstone beds which are underlaid by more yielding clays and sands. The absence of Orange sand is noteworthy.

The same general group of deposits doubtless obtains in 12S., 18W., section 30, where as stated above, Owen found "Tertiary" sandstone and shales, associated with the lignitic bed.*

Geology about Camden.—The vicinity of Camden is extremely interesting from a geological point of view, in that it furnishes the most extensive outcroppings of the Lignitic stage known in Arkansas. On account of these extensive and typical exposures, Hill has given the name "Camden series" to all the deposits recognized by him in southwestern Arkansas, as belonging to the Tertiary system.†

The most striking feature regarding these outcrops is the preponderance of arenaceous material. To be sure there is more or less agillaceous matter scattered through nearly all the beds, and to this constituent doubtless the permanence and perpendicularity of many of the bluffs are due; but the few purely clay beds are compartively insignificant and grade out laterally into almost pure sand. Lignitic matter is often present to such an extent as to give the surface of an outcrop a dark gray color, but this material will generally be found upon close examination to be finely comminuted and mixed with a much greater amount of white fine qurtz sand. This peculiar feature is remarkably pronounced all along the ravine in the south central part of the town, crossed by both the St. Louis Southwestern and the Camden Division of the St. Louis, Iron Mountain and Southern Railways. Both above and below the lower terminus of this ravine there are high bluffs along the right bank of the Ouachita which are difficult of ascent, and often perpendicular. This is especially true of those just below where they rise about 70 feet above the river at a mean stage.

---

*See Rep. of Geological Reconnoissance of Arkansas, 1860, p. 230.

†Annual Report of the Geological Survey of Arkansas for 1888, vol. II, pp. 50–188.

These will suffice to show the general nature and characteristics of the Lignitic beds of Arkansas.

Missouri.

We have little or no definite knowledge regarding the Tertiary of Missouri, though the lowlands of the southeastern portion are supposed to be underlaid by beds of this and perhaps the Cretaceous age. We are gratified to know that the present State Geologist is about to take this matter in hand, and it is to be hoped that this portion of the State will soon be mapped and its fossil faunas made known.

Illinois.

References : — Geological Survey of Illinois, vol. i, p. 44 et al., 1866, — Worthen. Geological Survey of Kentucky, Report on Jackson's Purchase Region, 1888, pp. 45–46, — Loughridge.

We have not personally visited the Tertiary deposits of this State and cannot say to what stage they belong, but it is reasonable to suppose that they should be classed as Midway or Lignitic or probably as both. The siliceous gravels and conglomerates remind one strikingly of those found in southwestern Arkansas. Worthen says : "This system [Tertiary] has only been identified in the southern portion of the State, and appears to attain its greatest development in Pulaski county, where it is represented by a series of stratified sands and clays of various colors, with beds of siliceous gravel, often cemented into a ferruginous conglomerate by the infiltration of a hydroxyd of iron. A marked feature of this system, in Pulaski county, is the presence of a bed of *green marly sand*, which from its lithological characters was at first supposed to be the equivalent of the Cretaceous green sand of New Jersey. An examination of the fossils which it affords, however, seems to leave no doubt of its Tertiary age. They consist of marine shells, belonging to the genus *Cucullæa* and *Turritella*, in the form of casts, the shell itself having been dissolved and entirely removed, so as to perclude the possibility of specific identification. A single shark's tooth was obtained from this bed near Caledonia. Along the edge of the Ohio, at Caledonia, there is a thin bed of *lignite* to be seen, at extreme low water. It is only a few inches thick, and forms the lowest stratum of Tertiary exposed in the vicinity.

"At Ft: Massac, on the Ohio, just above Metropolis, the ferruginous conglomerate already mentioned is from forty to fifty feet in thickness. * * * Siliceous wood, in a fine state of preservation has been found quite abundant in the Tertiary beds in Pulaski and Alexander counties."

Loughridge gives the Caledonia section as follows:

1.	Brown loam	10 feet
2.	Silt or loam	10 feet
3.	Gravel	5 feet
4.	Dark sandy clay, indurated	20 feet
5.	Dark joint clay, weathering into a gray shale and with cracks running S. 20° W	25 feet
6.	Greensand (glauconite) with hyaline sand; also some black sand and clay	2 to 4 feet

The lower moiety of this bluff is undoubtedly Eocene Tertiary, but as remarked before its exact horizon is unknown.

Kentucky.

References: — Geol. Surv. Ky., vol. i, pp. 21–24, 1856, — Owen. Am. Jr. Sci., 2nd ser., vol. 27, 364, 1859, — Lesquereux. Proc. Ac. Nat. Sci. Phila., 1886, p. 57, — Heilprin. Geol. Surv. Ky., Jackson's Purchase Region, pp. 41–52, 1888, — Loughridge.

Some of the bluffs along the Mississippi river, presumably referable to the Lignitic stage of the Eocene were visited by D. D. Owen as early as 1854, and described by him in 1856 as "Quaternary beds" "quaternary lignite" etc. In 1859 Lesquereux identified the following species from the "chalky banks of the Mississippi River near Columbus, Ky:"

Quercus virens Michx., *Castanea nana?* Muhl., *Ulmus alata?* Michx., *Planera gmelini* Michx., *Prinos integrifolia* Ell., *Ceanothus americanus?* Lin., *Carya olivæformis* Nutt., *Gleditschia triacanthos* L., and *Acorus calamus.*

In 1888 Loughridge describes other fossiliferous outcrops which may belong to the Lignitic stage, as follows:

"On the road leading south from Paducah, and at points there and four miles distant, fine exposures are traced in the deep washes by the side of the road.

"There is a broad valley on the south of Eden's hill and on rising from this valley, going southward, the most northern of these outcrops is seen. The next exposure is about one mile farther south, or on the south side of this hill, consisting of twelve feet (exposed) of lignitic joint clay, below four feet of micaceous sand-rock, in which are large numbers of casts of Lower Eocene fossils; about thirty feet of Quaternary gravel and loam overlie the bed. The strata seem to dip slightly to the north.

"The laminated sand-rock is again exposed a mile south, on the eastern edge of the hill of hard Onondaga quartzite at Mr. Byer's; its outcrop is about fifty feet thick; the strata are in an almost vertical position, and have a north and south strike. It is in the bed of the creek, and may have fallen in at some time by the undermining action of water, though it is not broken up and its bedding is very regular. Casts of fossil shells were also found here. Its surface is about five feet below that of the outcrops on the north side of the valley, in the section just described. On the west side of the hill of quartzite, and but a short distance from this sand-rock, a well, when dug, struck blackish joint clay at about fifteen feet, and penetrated it for thirty-five or forty feet without passing through it." * * *

Fossil casts found here have been determined by Prof. Heilprin, of the Philadelphia Academy of Science, to comprise the following:

"*Mysia.* — species probably *M. ungulina.*
Leda. — species probably *L. protexta.*
Leda — species indet.
Nucula. — species probably *N. ovula.*
Turritella. — species *Turritella mortoni.*"

—*Heilpin.*

Loughridge establishes a basal Eocene stage in Kentucky under the name of "Hickman group;" which represents to some extent the northern extension of the Midway of Mississippi and Tennessee. The above quotations are taken from what he terms the "Lignitic group," concerning which he makes the following general statement: "This, the next lowest division of the Eocene, embraces the two groups of Safford's Tennessee, viz: Porter's creek and bluff lignite, which he supposed were separated by his Lagrange beds, but which are in reality one and the same bed, as shown in the bluff of the Ohio on the Illinois shore at Caledonia, as well as by the continuity of the belt on the east, north and west of the Purchase region."

By consulting Bulletin Amer. Paleont. vol. i, p. 136 it will be seen that the Porter's creek group is for the most part Midway.

Tennessee.

References: — Amer. Jr. Sci., 2d ser., vol. 27, 363–365, '59, —Lesquereux. Amer. Jr. Sci., 2d ser., vol. 37, pp. 368–370, '64,—Safford. Geology of Tennessee, 1869.—Safford. Ann'l Rep't Geol. Surv. Arkansas, '89, vol. 2, p. 28, '91, — Call. Bull. State Board of Health (Tenn.) vol. v, No. 7, pp. 98–106, '90,—Safford.

The first important article on the Neozoic of Tennessee was by James M. Safford, entitled "On the Cretaceous and superior formations of West Tennessee." In his generalized section of these beds the terms he used to designate the different Tertiary formations are as follows:

"6. Bluff Lignite, (provisional), Tertiary?
5. Orange sand or LaGrange Group, Tertiary.
4. Porter's Creek Group, (provisional), Tertiary?"

He then very correctly correlates this Porter's creek group with the "Flatwoods" region of northern Mississippi, i.e. the upper part of the Midway stage as now understood. Of his LaGrange group he says: It occupies a belt about forty miles wide, which runs in a north north-easterly direction through nearly the central portion of this division of the State. As seen in bluffs, railroad cuts, gullies, and in nearly all exposures, it is generally a great stratified mass of yellow, orange, red or brown and white sands, presenting occasionally an inter-stratified bed of white, gray, or varigated clay. * * * It is difficult to estimate the thickness of the group. It doubtless dips, though at a slight angle, to the west. Its thickness may be assumed to be about 600 feet.

Three miles north of Somerville he collected a series of fossil leaves beautifully preserved in a thin sandstone in place. These were named or described by Lesquereux in the American Journal of Science 2d ser., vol. 27, p. 363, 1859, as follows:

1. *Quercus myrtifolia* Willd.; 2. *Prunus caroliniana* Michx.; 3. *Laurus carolinensis?* Michx.; 4. *Fagus ferruginea* Michx. (fruit); 5. *Quercus crassinervis?* Ung.; 6. *Quercus saffordi* Lesqx.; 7. *Andromeda vaccinifoliæ affinis*; 8. *Andromeda dubia* Lesqx.; 9. *Elæagnus inæqualis* Lesqx.; 10. *Sapotacites americanus* Lesqx.*; 11. *Salix densinervis* Lesqx. Though Lesquereux supposes these beds to be of Upper Miocene age, Safford very properly classes them as Eocene.

Of the "Bluff lignite" Safford remarks that it is but a "provisional group" generally well exposed below the gravel of the Mississippi bluffs, but may thin out in an easterly direction. He gives a section of those beds at Randolph, Tipton county, in which lignitic sandy beds are 190 feet in thickness.

Lesquereux's new species and a few others are figured in Safford's Geology of Tennessee, 7; and the general statements regarding the Neozoic of western Tennessee as referred to are reiterated in this State report.

So far as we are aware no molluscan fossils have been found in this State from the La Grange or Bluff sands—deposits that presumably belong to the Lignitic stage.

Mississippi.

References:—Amer. Jour. Sci., vol. i, p. 324, 1819,—Cornelius. Prelim. Rept. Geol. Agr. Miss., 1857,—Harper. Rept. on Geol. and Agr. Miss., 1810,—Hilgard. Proc. Amer. Asso. Adv. Sci., vol. xx, 1871, p. 222, maps,—Hilgard. Amer. Jour. Sci.. vol. iii p. 271, 187,1—Hilgard. Amer. Jour. Sci., vol. 22, pp.

---

* This species is added to Lesquereux's list as published by Safford, 1864.

58–65,'88,—Hilgard. Contrib. Geol. and Paleont. U. S., p. 32, '84,—Heilprin.

Contrary to the prevailing ideas heretofore expressed, we believe the truly Lignitic deposits, i. e. those representing the Lignitic as we define them in Alabama, are not extensively developed in Mississippi save perhaps in the northern counties where they presumably represent the southern extension of Safford's La Grange group, and perhaps Bluff sand. Bordering the Cretaceous on the east are the Flatwoods clays representing doutless the Midway. On the west or southwest there is a fossiliferous Lower Claiborne horizon as indicated to some extent on Hilgard's map accompanying his report on the Agriculture and Geology of Mississippi. The "outlier" of this latter horizon about Vaiden is doubtless simply a fossiliferous phase of the same and should be connected with the Lower Claiborne to the southeast, thus embracing a considerable of the so-called "Northern Lignitic" area in the Lower Claiborne. So far as we are aware no molluscan fossils have been found in the Lignitic of this State; that the fossils at Vaiden are of Lower Claiborne age there can be no doubt for we have made satisfactory collections from that locality.

Hilgard in 1871 subdivided his Lignitic into Flatwoods and La Grange beds, and gave them the total thickness of 450 feet. From our observations in Tennessee, Mississippi and Alabama it would seem that 200 feet would not be an unreasonable estimate for the Midway (Flatwoods) beds of this State, leaving therefore 290 of La Grange deposits.

Heilprin has suggested an extension overlapping in this "Northern Lignitic" of Jackson beds, including the Vaiden fossiliferous deposits. In this he is wrong, for the Jackson beds as they passed northward would pass west of Vaiden, through the Yazoo-Mississippi flats where they have long since been carried away. The Arkansas limb of the northern extension of the Jackson is in a better state of preservation.

Alabama.

References:— Trans. Amer. Philos. Soc., vol. 6, 1st ser. p. 411, 1809,—Maclure. Trans. Amer. Philos. Soc., vol. i, 2d ser., 1817,—Maclure. Jour. Acad. Nat.

Sci., Phila. vol. 6, '28,—Vanuxem. Amer. Jour. Sci. 2d ser., vol. 6, p. 354, '48,—Hale. First Biennial Report on the Geology of Alabama, '50,—Tuomey. Proc. Ac. Nat. Sci. Phila., p. 449, '53,—Conrad; p. 166, '57,—Conrad; '64, p. 212,—Conrad. Proc. Amer. Ass. Adv. Sci., vol. x, p. 82, '57,—Winchell. Second Biennial Report on the Geology of Alabama, '58,—Tuomey. Jour. Acad. Nat. Sci. Phila., vol. 4, p. 291, 1860,—Conrad. Amer. Jour. Conch. vol. i, p. 259, '65,—Whitfield. Contr. Geol. and Pal. U. S., '84,—Heilprin. Proc. Acad. Nat. Sci. Phila., '80, pp. 364–375,—Heilprin; '81, p. 151,—Heilprin. Bull. 43 U. S. Geol. Surv., '87,—Smith & Johnson. Bull. 1, Geol. Surv. Ala., '86,—Adrich. Bull. Geol. Soc. Amer., vol. ii, p. 587, '91,—Langdon. Geol. Surv. Ala., '95,—Smith, Aldrich, Langdon. Amer. Jour. Sci., vol. 47, p. 301, '94,—Harris. Dana's Manual Geol., p. 888, '95,—Harris. Bull. Amer. Pal. No. 2, '95,—Aldrich. Bull. Amer. Pal., No. 8, '97,—Aldrich. Bull. Amer. Pal., No. 4, '97,—Harris. Proc. Acad. Nat. Sci. Phila., '96, p. 470,—Harris.

Historical notes.—This is, and ever will be, the classic or type State for the marine Eocene series in America, and it is especially true of the stage now under consideration, for while beds presumably representing this stage in Texas, Arkansas, Mississippi and other States are well developed and present some interesting features, they are nearly or wholly destitute of molluscan fossils, a want that renders their age and boundaries vague or ill defined. It seems then worth while to pause and study the development of Lignitic stratigraphy and paleontology under this heading.

Passing at once over the vague generalities of Maclure and the somwhat reformed classification of Neozoic terranes by Vanuxem, the first account of a personal observer in the Lignitic deposits of this State is that of C. S. Hale, 1848. He attempted the establishment of a generalized section of the Eocene of this State as follows:

8 & 9. White limestone.
7. Sand and shells.
6. Clay bed with oysters.
5. Marly arenaceous limestone.
4. Clay bed with oysters.
3. Sand and shells.
Section of the Claiborne bluff.
2. Lignite
1. (or lowest) Clay bed.

It is bed No. 3 of this section, viz., the basal bed of the Claiborne escarpment that he supposed expanded to the north and included all fossil bearing rocks as far north as Black's bluff on the Alabama and Woods bluff on the Tombigbee. Between Tate's ferry and Upper Peach Tree on the Alabama, and between Woods bluff and Black bluff on the Tombigbee, beds 1 and 2 are found.

We recognize at once in this classification our upper Midway beds in No. 1, lower Lignitic beds in No. 2 and upper Lignitic and Lower Claiborne in No. 3.

Hale was evidently a close observer, for in speaking of the fossiliferous deposits of Clark county on "Bashui creek" he says that they: include nearly all the different species of testacea common in other parts of the series, together with many new ones, some of which are unique. Of the latter may be noticed a *Rostellaria*, differing from Lea's *R. lamarckii* in having a more attenuated rostrum, and a very prominent tubercle on the back of the body whorl [*Calypt. trinodiferus Con.*]. Also a species of *Voluta*, having a general resemblance to *V. luctator* of the London clay, but differing in a remarkable deposit of enamel behind the aperture, forming a large bourelet covering half the spire to the summit, enveloping also the folds of the columella, and otherwise flattening and deforming the symmetry of the aperture [*V. tuomeyi Con*]. Also a new species of *Tornatella*, shell robust, spirally fluted with flattened ribs, spire attenuated, two stout folds on the columella, outer lip denticulate [*Tornatellæa bella Con.*], etc., etc.

About simultaneously with Hale's explorations were the first beginnings of Michael Tuomey's studies of beds now classed in the Lignite stage of the Gulf slope. Upon being appointed professor of Geology in the University of Tuscaloosa it was one of his duties "to spend such portions of his time, not exceeding four months of each year, in exploring the State, in connection with his proper department, as the Trustees may consider for the advantage of the State."

These explorations commenced in 1847, and such extracts from the reports made to the Trustees, as were thought to be of general interest appeared in the newspapers of Tuscaloosa. In 1848 Tuomey was appointed State Geologist and in 1850 his First Biennial Report appeared. Therein his description of the Lignitic Eocene of Alabama reads as follows:

"A few miles southwest of Prairie Bluff, a very marked change may be observed in the face of the country. As the Dumas settlement is approached, the surface becomes broken, and the long-leaf pine is almost the sole occupant of the high and sandy ridges.

"Along the State road, the physical features of the country are such as could not be mistaken by any one who had studied the Tertiary of North or South Corolina. The same magnificent growth of pines, and the same sandy surface, scarcely concealed by the tufts of harsh wiry grass.

"About two miles north of Choctaw Corner, the surface beds are removed by the streams that flow into Horse creek. These little rivulets are shaded in their course by groves of magnolias of striking beauty, of which superb genus three or four species may be seen together: *Magnolia grandiflora*, two feet in diameter, and emulating in height the tallest trees of the forest; *M. tripetela*, with its long narrow leaves; *M. macrophylla*, and *M. auriculata*, all in the same clump.

"Some of the most remarkable beds of lignite in the State, are found upon each side of the point where the public road crosses the creek. On the west, the stream has encroached on the bank, and laid the deposit bare. The lignite has lost all traces of woody structure, is quite homogeneous and compact, resembling the black mud of peat-bogs, when partially dried. It is intersected by joints that cross it in various directions, and presents a sufficient disposition to split into laminæ, to remind one of cleavage. It is impossible, at this locality, not to recognize some of the steps in the conversion of vegetable matter into coal. This bed passes upwards into a black clay colored by intermixture with lignite, and rests upon a bed of blue and fine sand, which is sometimes sufficiently indurated to form sandstone ; the latter is better seen lower down the creek.

“ *Section on Horse Creek.*

1.	Surface beds..	
2.	Dark clay..	3 feet
3.	Lignite..	3 feet
4.	Blue sand, and sometimes sandstone....................	

“ About a mile from Choctaw Corner, a highly interesting locality was pointed out to me by Mr. Worrel : at this place, I saw the preceding bed of lignite, with the addition on the the top of a bed of marl four feet thick, containing a considerable proportion of green sand, having embedded in it *Cardita planicosta*, and other easily recognized Eocene fossils ; the whole resting upon a stratum of blue sand.

“The following diagram exhibits the order of super-position, and thickness of the beds at this locality :

“*Section on Bashi Creek.*

1.	Hard limestone..	4 feet
2.	Marl highly fossiliferous..................................	25 feet
3.	Blue sand. Variable......................................	
4.	Lignite and clay..	6 feet
5.	Laminated clay, sand, and mud. Thickness undetermined..	
6.	Lignite. Thickness undetermined....................	

“1. This is a bed of hard rock, differing in composition but little from the marl which underlies it, excepting in its greater hardness. It appears to overlie the marl pretty generally, for I found it at localities miles distant. When cut through by the streams, or fissured (which is often the case) from any cause, the marl below is washed out, and caves of small extent are formed.

“2. The marl of this bed presents all the characters of the substance so called in Virginia, excepting perhaps, that the fossils are in a finer state of preservation, than any found in the Eocene beds of that State. Green sand is also disseminated through this ; all the dark colored grains, however, do not belong to this mineral. Green sand is readily distinguished by the green streak left, when a grain is crushed upon a piece of white paper, with the moistened point of a knife.

"3. This is a bed of bluish sand, the thickness of which was concealed, as the section is only traced by following the stream in its downward course along its channel ; the beds being often in part concealed from the sliding down of the surface beds.

"4. The overlying black, tenaceous clay, and lignite of this part of the section, differ in no respect from a similar bed already described. In the laminated clay, leaves of dicotyledinous plants are not uncommon.

"5, 6—Represent beds seen on another part of the stream below the preceding.

"The following are among the most abundant fossils at this locality :

Ostrea compressirostra.
Cytherea.
Cardita planicosta.
Rostellaria velata.
Actæon pomilius.
Voluta sayana?
Cardium nicolleti.
Infundibulum trochiformis.
Solarium.

"The oyster shells found here are large and and ponderous, and resemble very closely a variety of *O. compressirostra* found on Santee canal, South Carolina.

"*Rostellaria velata* has a longer and more attenuated canal than the Claiborne fossil. *Cardita planicosta* is in finer preservation than I have seen it elsewhere, The fossil that I have referred with doubt to *V. sayana*, at certain stages of growth, has a thick callus on the columella, which partly conceals the spire.

"Whether this be a prolongation of the Claiborne bed or not, I am as yet unable to decide. The mineral composition is different ; and although the greater number of fossils are identical with those of Claiborne, yet as a group they are very distinct, besides containing forms not found at that locality. But these differences, considering the wide interval between the two localities, are quite consistent with their identity.

"Five or six miles south of Choctaw Corner,* and on the east of the way to Macon, on the road to Tallahatta springs, thick ledges of rock are seen outcropping toward the top of the hills, and associated with a stratum of white silicious, and in some places indurated, clay. The surface of the beds of rock is often covered with silicified shells, much broken up, but often capable of being determined. I found here *Cardita planicosta*, and *Petcunculus idoneus*. I traced these beds to Tallahatta springs, where, on the top of a hill, this rock had been quarried for millstones. The hills capped with this white silicious clay, conspicuous throughout this region, are known between the Springs and the Corner, as chalk hills. It was easy to recognize these beds so characteristic of the Buhr-stone formation of Georgia and South Carolina. Still, I am in doubt as to the position of this fossiliferous formation, in relation to the fossiliferous beds of Choctaw Corner.

---

* This name is now transferred from the place indicated on the map, to where the post office is kept.

"The country is here really hilly and broken, and a ridge extends across to the west side of the Tombigbee, where, 13 or 14 miles north of Barrytown, it overlooks the valley of the river. Taken altogether, the Buhr-stone formation gives rise to the most rugged and hilly region of the lower part of the State, and it is equally remarkable for sterility of soil.

"On a stream, called in the neighborhood Etishlakare, about 15 miles north of Barrytown, beds of marl occur similar to those on Bashi creek, and this is the farthest north that I have been able to trace them, and at this locality the order of super-position is equally uncertain."

From this it appears that Tuomey had not yet realized the true stratigraphic position of the Lignitic beds about Bashi creek. The "*Voluta sayana*" referred to by Tuomey was afterwards, 1853, described by Conrad as *Athleta tuomeyi*. Conrad adds: Mr. Tuomey says the group of fossils in this locality [Bashi creek, Clark county,] are very distinct from those of Claiborne, and I have no doubt the deposit will prove to be an upper bed of the Eocene which may, when the fossils are all collected, be found to contain some of the species of the Older Miocene as it occurs at Vicksburg, Miss. "The *Athleta tuomeyi*, though a very distinct shell, is related to a Miocene fossil of Dax (*A. rarispina*), which is an abundant species."

In 1864 Conrad described *Turritella præcincta*; in 1857 he described *Calyptraphorus trinodiferus* "from the Eocene of Alabama, Dr. Showalter."

In 1856 Prof. A. Winchell read before the American Association for the Advancement of Science some "Notes on the Geology of Middle and Southern Alabama." He recognized certain beds at the base of the Eocene, including the Midway stage of to-day and perhaps some Lignitic beds, as distinctly older than the Buhr-stone and constituting the base of the Eocene series.

Winchell accordingly classified the lower Midway beds as known to-day ,with perhaps some Lignitic beds, as Buff sand, immediately above which came his Buhr-stone. He apparently overlooked the fact that Hale eight years before had set off the lignite sands and clays (No's. 1 & 2) as distinctly older than the beds to the south, afterwards referred to the Buhr-stone and now classed as Lower Claiborne and upper Lignitic.

After Tuomey's death his 2nd Biennial report was edited by J. W. Mallet, 1858, and lists of fossils are given in the various appendices of the work from Nanafalia bluff and Bell's landing. It appears that he and his assistants had explored with some care nearly all the Eocene district of the State, but the report is extremely fragmentary and nowhere do we find a definite statement of the stratigraphic relations of the Lignitic deposits to those farther south. The term Buhrstone seems to have been used to designate the lower moiety of the Eocene in Alabama.

After Tuomey's death and Winchell's departure from Alabama, Dr. Showalter of Uniontown, Alabama, sent Conrad of the Philadelphia Academy severnl new molluscan fossils now known to have come from Lignitic outcrops, though their horizon and location is vaguely defined by Conrad as "a locality farther north in Alabama than any Mr. Tuomey had explored." These include *Exilia pergracilis*, *Simpulum showalteri*, *S.* (*Epidromus*) *exilis*, *Con.*, *Murex morulus Con.*, *Pseudoliva tuberculifera Con.*, *Acteonina subvaricata Con.*, *Tornatellæa bella Con.*, *Turbonilla trigemmata Con.* Others collected by T. J. Hale reached the cabinet of James Hall and were described in 1865 by R. P. Whitfield. They include *Pyrula juvenis*, *Fulgur triserialis*, *Pleurotoma nasuta*, *P. capax*, *Voluta newcombiana*, *Natica erecta*, *N. perspecta*, *N. onusta*, *N. alabamiensis*, *N. aperta*, *Velutina expansa*, *Potamides alabamiensis*, *Turritella eurynome*, *T. multilira*, *Cucullæa macrodonta*, and *Crassatella tumidula*.

Early in the seventies Prof. E. A. Smith began investigating the coastal plain of Alabama ; and as early as 1880 he sent collections from Bashi creek and Woods bluff, to the Philadelphia Academy for identification. Prof. Heilprin correlated these deposits with those of upper Marlborough and Piscataway rivers, Maryland, and Pamunkey river, Virginia, listed the species and described in the Academy's Proceedings as new : *Cytherea nuttalliopsis*, *Pseudoliva scalina*, *Lævibuccinum lineatum*, *Fusus subtenuis*, *F. interstriatus*, *F. engonatus*, *Strepsidura subscalarinus*, *Pleurotoma moniliata*, *Pyrula multangulata*, *Solarium cupola*, *S. delphinuloides*, *Dentalium micro-stria*.

The next year Prof. Heilprin furnished the Proceedings with some "Notes on the Tertiary Geology of the Southern United States." From Smith's notes he gives a section at Woods bluff, near the mouth of Bashi creek, and also a crude diagram representing the Woods bluff beds as passing beneath, i. e. stratigraphically below the "Buhrstone." He coins the term Eo-lignitic for these sub-buhrstone deposits and thus subdivides the whole Alabama Eocene :

4.	"White limestone" (Jacksonian)	50? feet
3.	Claibornian	17 feet
2.	"Buhrstone" (Siliceous Claiborne of Hilgard) about	250? feet
1.	Eo-lignitic	50? feet

Practically the same conclusions are reiterated in "Contributions to the Tertiary Geology and Paleontology of the United States" published in 1884, though attention is called to Johnson's note in Science, vol. ii, 1883, indicating a considerably greater extension of the Eocene to the northward than geologists were generally aware of.

It is, however, to Prof. Smith that our present knowledge of the Lignitic stratigraphy of the State is mainly due. His labors in this field he briefly summrizes as follows :

"During the summer of 1883 a trip was made by the authors, in a small steamer, down the Tuscaloosa (also called Black Warrior or Warrior) river, from Tuscaloosa to its confluence with the Tombigbee, down the latter stream to its confluence with the Alabama, down the Alabama and Mobile rivers to the head of Mobile bay, and thence up the last two rivers to Prairie bluff.

* * * * * * *

"The trip by steamer was made at the joint expense of the U.S. Geological Survey and the Geological Survey of Alabama.

"The first draft of this bulletin was prepared with the data collected during this trip, there being added thereto information gathered by myself in 1872, 1880, 1881, 1882, and 1884 for the Geological Survey of Alabama and for the Tenth Census of the United States and information obtained by Mr. L. C. Johnson in 1881, 1882, and 1883. The bulletin was not completed until I had gone over the whole ground again, in the summer of 1885, in company with Messrs. T. H. Aldrich and D. W. Langdon, of the Geological Survey of Alabama. Finally, the results of my investigations in the same region during the summer of 1886 have been in large part incorporated."

During this field work, extensive collections of Eocene fossils were made by members of the State Survey and Mr. T. H. Aldrich; and the latter prepared from this material an illustrated monograph on the Eocene mollusca of the State (Bull. 1, Geol. Surv. Ala., 1886.)

The stratigraphic work was published as Bull. 43 of the U. S. Geological Survey, and, therein the following subdivisions and names were included under the Lignitic:

Lignitic.	Hatchetigbee	175 feet
	Wood's bluff	80 to 85 feet
	Bell's landing	140 feet
	Nanafalia	200 feet
	Matthews landing & Naheola	130 to 150 feet
	Black bluff	100 feet
	Midway	25 feet

These works, it will be observed, bear mainly upon the Eocene stratigraphy as shown along the Alabama and Tombigbee rivers. But D. W. Langdon, an assistant on the State Survey, continued the work on eastward, and in 1890 read before the American Geological Society a paper embodying many of his conclusions on deposits farther east.

In 1894 the State Survey published a report embodying among other matter all the then known Lignitic stratigraphy. The Alabama type section was revised to read:

Lignitic.	Feet.
a. Hatchetigbee	175
b. Bashi or Wood's bluff	80 to 85
c. Tuscahoma or Bell's landing	140
d. Nanafalia	200
e. Naheola or Matthews' landing	130 to 150
f. Sucarnochee or Black bluff	100
Clayton (Midway)	25 to 200

It will be observed here that the Midway has been separated out from the Lignitic, but that the Matthews' landing and Black bluff beds are still retained in this stage.

The distribution of the different substages of the Lignitic are shown on a large geological map of the State accompanying this work.

Since the publication of these stratigraphic works Mr. Aldrich has written two Bulletins (Bull. Amer. Paleont. No's 2 & 8) describing among other Eocene shells many from the Lignitic stage. The present writer has also contributed an article to the Proceedings of the Philadelphia Academy of Natural Sciences wherein are described and figured several Lignitic species.

Stratigraphy.—In passing down the Tombigbee from the last characteristic Midway exposure, viz, Naheola, various bluffs are seen on either side of the river, blackish and clayey at first but becoming more grayish or yellow and arenaceous downstream, until the famous Nanafalia exposure is reached. Here fossils which seem to be exceedingly scarce in the stretch just described, become very noticeable. Here the river is deflected to the west principally or primarily by an indurated ledge of marl which shows a moderate southern dip. Its height above water depends accordingly upon the exact point examined and the stage of the water at the time.

The section as given by Smith and Johnson is as follows :

Section of Nanafalia landing, Tombigbee River.

" 1. Greensand marl, highly fossiliferous, containing chiefly *Gryphæa thirsæ* Gabb, but holding also *Turritella mortoni* Con., *Flabellum*, and a few other fossils. This marl makes a tolerably firm rock, with a line of indurated, projecting bowlder-like masses 12 to 18 inches thick of nearly similar material along the whole length of the bluff and near the middle of the bed..........about 20 feet.

" 2. Dark blue, almost black, laminated clay, devoid of fossils, but passing below gradually into a bluish marl...3 to 4 ft.

" 3. Bluish greensand marl, with a few shells in the upper 3 or 4 feet, but more highly fossiliferous below. This bed contains a great variety of beautifully preserved and easily detached fossils. The fossils can be collected only during very low stages of the water......................8 to 10 feet.

It is from the under side of the indurate masses that break off and are turned on one side or bottom side up along the cliff that our best fossils were obtained. Numerous cavities are noticeable all along this ledge where huge *Venericardia planicosta* and *Ostrea compressirostra* have been dissolved out. But by far the most characteristic fossil of this horizon is the *Gryphæa thirsæ* of Gabb. Other fossils are: *Venericardia alticostata* var., *Crassatella halei*, *Cardium tuomeyi*, *Pectunculus*, *Levifusus pagoda* (very large and spinous), *Turritella humerosa*, *T. mortoni*, *Cornulina armigera*, *Calyptraphorus trinodiferus*, *Volutilithes petrosus*, *Capulus complectus*, *Mesalia alabamiensis* (2 var.) *Pseudoliva scalina*, *et. al.*

In going down the river below Nanafalia a characterstic feature of the outcrops is the number of enormous concretions they exhibit. These show clearly that the dip of the strata is southward, though reverse dips and local unconformities are noticeable. Dark lignitic and grayish sands, more or less indurated prevail for a number of miles. At Tuscahoma landing there are no such fossiliferous beds as at Nanafalia, yet Aldrich has secured from them several new species. The species noted by the writer are: *Turritella mortoni*, *T. præcincta*, *Levifusus pagoda* *Volutilithes petrosus*, *Calyptraphorus trinodiferus*, *Pleurotoma capax*, *Venericardia planicosta*, *Pectunculus sp.* These were picked out from the bank four feet above water level (about July 1) just below the landing.

The next outcrop of any considerable importance is formed by a low bank on the south side of the river as the latter swings westward, near the mouth of Bashi creek. The fauna is decidedly upper Lignitic and hence is closely allied to that of Woods bluff. Here were obtained: *Ostrea* var. *sylværupis*, *Meretrix nuttalliopsis*, *Corbula aldrichi*, *C. concha*, *Cornulina armigera*, *Hemifusus engonatus*, *Volutilithes petrosus*, *Pseudoliva vetusta*, *Tornatellæa bella*, *Pleurotoma tombigbeensis*, *Pleurotoma sp.*

The next well known fossiliferous outcrop is at Woods bluff. Here the following beds were observed:

1.	Soil, sand, pebbles at base	40 feet
2.	Black clay, about	8 feet
3.	Line of concretions	4 inches
4.	Fossiliferous reddish and variegated clay	3 to 6 feet
5.	Black clay	10 feet
6.	Reddish fossiliferous sand	2 feet
7.	Fine gray fossiliferous sand	5 feet

8. Concretions with large *O.* var. *sylværupis*........... 3 feet
Water level...

Fossiliferous sands below No. 8 have furnished, during extreme low water, a fine fauna, specimens from which were figured in the writer's recent article in the Philadelphia Academy's Proceedings. No. 8 is a concretionary layer in part, and in part simply an indurated band averaging two or three feet in thickness with very uneven and undulating superior and inferior surfaces. In these indurated layers are found large and well defined *Ostrea* var. *sylværupis*. No.7 contains a very rich fauna. No. 6 is but a sandy, grayish fossiliferous phase of No. 5 and contains *Clavilithes*. No. 4 is not so fossiliferous as No. 7, but contains many well preserved specimens of *Volutilithes petrosus*, and *Levibuccinum striatum*.

The more common species from this now famous exposure have already been listed by Heilprin and Aldrich.

At Coffeeville a lower Claiborne deposit occurs, but several miles below at Hatchetigbee bluff an uppermost Lignitic outcrop is found. For perhaps 20 feet above water line finely laminated dark clays predominate. Towards the lower end of the exposure or cliff there is an upstream dip which brings to day two or three layers of *Venericardia planicosta* often with valves united, almost as perfect as the shells strewn along the shores of modern seas. In with these *Venericardia* one observes *Pseudolivæ* and an occasional *Cornulina*. From 10 to 20 feet above water level one finds concretions, and, adhering to their lower surface are not a few well preserved shells. Ledges of light colored material (buhrstone?) occur here and there from 20 feet upwards, but brownish clays predominate. High up in the latter one finds the most and best fossils. This bluff has furnished Aldrich and the writer several new species, some of which have been named after the bluff—*hatchetigbeensis*.

About three miles north of Pine Hill there is a railroad cut which exposes at its northern terminus—about ⅙ mile south of Turkey creek—about five feet of light clay with a few rather obscure fossils in its uppermost layers. By passing southward it will be seen that a ferruginous greensand containg a fauna of Naheola affinities overlies the clay. *Astarte* var. *mediavia* is quite common here. Other clays appear, some bearing quartz pebbles and some laid down more or less unconformably upon each other ; thickness 20 feet. At the summit of these deposits there is a fossiliferous streak containing quite a number of small, imperfect oysters. Perhaps 20 feet higher still, and at the south end of the cut a bed of *O. thirsæ* comes in. Beds of this species stretch along the railroad for over a mile towards Pine Hill. A few *Venericardia planicosta* and *Turritella mortoni* are sprinkled in here and there. This section is interesting, for it shows within a few feet the dividing line between the Lignitic and Midway stages.

Along the Alabama river south from the famous Matthews' landing outcrops of Midway clays beds of dark sandy and lignitic clays give place to the Nanafalia marls at Gullettes' landing, replete with *Ostrea thirsæ*. The best collecting ground, however, does not appear until Yellow bluff is reached. This is practically the same fauna as that at Gregg's landing. Large specimens of *Ostrea compressirostra* and *Venericardia planicosta* are fairly abundant, but the fauna is principally of gastropods, including *Turritella mortoni*, *T. humerosa*, *T. præcincta*, *Mesalia alabamiensis*, *Calyptraphorus trinodiferus*, *Voluta newcombiana*, *Pseudoliva vetusta*, *Fusus harrisi*, *Cornulina armigera*, *Levifusus pagoda*, *L. trabeatus*, *Natica limula*, *N. aperta*, *N. eminula*, *Pleurotoma nasuta*, *et. al; Pecten greggi*, and *Crassatella halei* are typically developed here.

Gregg's landing some miles below is perhaps the best lower Lignitic collecting ground in the State. There is no mass of fossils from which large quantities of any given species can be obtained, but by diligently picking over the cliff, from one end to the other a great variety of mollusca as well as corals can be obtained.

Farther downstream at Peeble's and Lower Peach Tree landing outcrops occur, not important for the number and variety of their fossil fauna, but containing noticeably large concretions, reminding one of the Tombigbee river above Tuscahoma.

Bell's landing, another very important outcrop, can be passed over with only a passing mention, for its strata and fossils have been studied with considerable care by Smith, Johnson and Aldrich. This is the last good exhibition of lower Lignitic beds on the Alabama.

Four miles above Hamilton bluff, as the river sweeps westward before its final southern deflection through the "Buhrstone" at Hamilton bluff, there is a low outcrop of upper Lignitic or Woods bluff marls on the southern bank of the river.

Some of the fossils collected here are: *Venericardia planicosta*, *Meretrix nuttalliopsis*, *Pectunculus idoneus*, *Corbula aldrichi*, *Plicatula filamentosa*, *Leda parva*, *L. protexta*, *Solemya alabamiensis*, *Pseudoliva vetusta*, *Calyptraphorus trinodiferus*, *Natica clarkeana*, *Fusus subscalarinus*, *Solariella sylværupis*, etc.

At Hamilton bluff white Buhrstone is the predominant rock.

It is much to be regretted that time and circumstances did not permit visiting the Woods bluff exposures described by Langdon, near Elba on Pea river. Ozark, however, is easily accessible by railroad and although the fossils near by are not well preserved, they do indicate very clearly the stages of the Eocene to which they belong. In the deep cut on the Midland railroad as it passes beneath the Savannah and Western, there is a layer about four feet thick, filled with fragments of shells, some being apparently whole but crumbling generally when removed from the matrix. The base of this stratum is from two to four feet above the railroad track, while below and above it are layers of nearly barren black clay.

It is difficult to see why this outcrop has been referred to the Claiborne horizon, for it is characterized by a very typical upper Lignitic or Woods bluff horizon. Some of the fossils are *Venericardia planicosta*, *V. alticostata*, *Leda protexta*, *Corbula aldrichi*, *Leda elongatoidea*, *Meretrix nuttalliopsis*, *Astarte smithvillensis*, *Turritella clevelandia*, *Fusus interstriatus*, and many others.

On the Savannah and Western road about 200 yards north of this cut, Buhrstone deposits occur on the east side of the track. This outcrop may be 38 feet above the cut.

Georgia.

References. — 10th Census U. S., vol. vi, Cotton Production, part ii, p. 280, 1884,—Loughridge. Bull. Geol. Soc. Amer., vol. ii, pp. 600–602, 1891,—Langdon. Geol. Surv. Ala., Rep't on Coastal Plain of Ala., pp. 406–419, 1895,—Langdon. Geol. Surv. Ga., 1st Rep't, pp. 46–47, and map p. 16, 1891,—Spencer. Amer. Geol., vol. 18, p. 236, 1896,—Harris.

Near Ft. Gaines, Georgia, the following stages and strata have been observed, commencing about five miles east of the bluff:

1. Vicksburg cherty limestone (5 miles east of Ft. Gaines)... feet

2.	Not well exposed; unfossiliferous where observed	40 feet
3.	Buhrstone, quarries 2 miles east of Ft. Gaines	10 feet
4.	Unfossiliferous Lignitic sands, 2-½ miles east of Ft. Gaines	70 feet
5.	Unexposed to top of bluff	20 feet
6.	Red clay, sand, and gravels (Pleistocene)	25 feet
7.	Lignitic clay	20 feet
8.	Fossiliferous sandstone ledge, *O. compressirostra*	3 feet
9.	Blue clay	6 feet
10.	Alternating hard and soft layers	20 feet
11.	Fossiliferous indurated marl (seen in bed of branch)	3 feet
12.	Bluish sandy clay	30 feet
13.	Sandy clay with concretions, *Ostrea thirsæ*	20 feet
14.	Midway limestone (See Bull. Amer. Paleont. No. 4.)	
	Water level	

This is certainly an interesting locality, showing as it does the Vicksburg and Midway beds in such close proximity. The Nanafalia and Yellow bluff horizon, viz., the lower Lignitic, is well represented and fossiliferous, while so far as observed the beds probably belonging to or representing an upper Lignitic horizon are barren. The lower Claiborne light colored sandstones east of the village are not thick, but carry an ample fauna, with the same species as seen at Hamilton bluff on the Alabama and along the Savannah and Western road perhaps ¾ mile north of Ozark.

Vicksburg beds form the surface rock at Cuthbert and three miles to the north. They occupy high hills as far as five miles north of this town. Nine miles to the north of Cuthbert Midway beds crop out on the northern slope of a hill. The estimated distance between the top of the Midway and the base of the Vicksburg is 200 feet. An exposure of no less than 100 feet of Lignitic and lower Claiborne exposure is seen in a deep valley 3½ miles north of town. Here and farther east, at least as far as Macon, no fossiliferous beds belonging to the Eocene series have been detected between the Vicksburg and Midway.

List of stratigraphic terms that have been applied to all or part of the Lignitic stage.

Alluvial rocks., partim, Maclure; Trans. Amer. Philos. Soc., vol. 6, map, 1809; vol. 1, New series, map.

Alluvial, partim, Cornelius; Amer. Jour. Sci., vol. 1, p. 324, 1819.

Alluvial, partim, Nuttall; Jour. Acad. Nat. Sci. Phila., vol .2, p. 42, 1821.

Bashi, Langdon; Bull. Amer. Geol. Soc., vol. 2 p. 596, 1891.

Bashi (*or Woods bluff*,) Smith and Johnson; Bull. 43, U. S. Geol. Surv., pp. 18 and 43, 1887.

Bell's Landing group, Smith and Aldrich; Bull. 1 Geol. Surv. Ala., p. 54, 1886.

Bell's landing, Smith and Johnson; Bull. 43, U. S. Geol. Surv., pp. 18 and 46, 1887.

Bluff lignite, Safford; Geol. Tenn., p. 428, 1869.

Buff sand, partim, Winchell; Proc. Amer. Assoc. Adv. Sci., vol. 10, p. 87, 1857.

Buhrstone, partim, Winchell; Proc. Amer. Assoc. Adv. Sci., vol. 10, p. 87, 1857.

Camden beds, Hill; Ann'l Rep't Geol. Surv. Ark., 1888, vol. 2, p. 188.

Camden series, partim, Hill; Ann'l Rep't Geol. Surv. Ark., 1888, vol. 2, pp. 49 and 188.

Eo-lignitic, Heilprin; Proc. Acad. Nat. Sci. Phila., 1881, p. 159; and Cont. to Tert. Geol. and Paleont. U. S., p. 30, 1884.

Fossiliferous clays at Ft. Gaines, Ga., Loughridge; Cotton Prod. Rep't 10th Census, part. 2, p. 280.

Gregg's landing marl, Bull. 1, vol. vi, Geol. Surv. Ala., p. 12, 1886.

Gryphæa thirsæ marl (*or Nanafalia*,) Smith and Johnson; Bull. 43 U. S. Geol. Surv., p. 39, 1887.

Heatchetigbee group, Smith and Aldrich; Bull. 1, Geol. Surv. Ala., p. 50, 1886.

Hatchetigbee, Smith and Johnson; Bull. 43, U. S. Geol. Surv., pp. 18 and 39.

Hatchetigbee, Langdon; Bull. Amer. Geol. Soc., vol. 2, p. 596, 1891.

Lagrange group, Loughridge; Rep't on Jackson's Purch. Reg., Geol. Surv. Ky., p. 52, 1888.

Lignitic, partim, Clark; Bull. 43, U. S. Geol. Surv., p. 58, 1891.

Lignitic, Vaughan; Amer. Geol., vol. 15, p. 209, 1895; Bull. 142, U. S. Geol. Surv., 15, 1896.

Lignitic, partim, Smith and Johnson; Bull. 43, U. S. Geol. Surv. pp. 18 and 38, 1887.

Lignitic beds, Dumble; Geol. Surv. Tex., Report on the Brown Coal of Tex., p. 130, 1892.

Lignitic stage, Harris; Ann'l Rep't Geol. Surv. Ark., 1882, vol. 2, p. 55.

Lignitic, Harris; Amer. Jour. Sci., (3), vol. 47, p. 304, 1894.

Lignitic, Harris; Dana's Manual of Geology, p. 888, 1895.

Lignitic group, Loughridge; Rep't Jack's Purch. Reg., Geol. Surv. Ky., p. 41, 1888.

Little Missouri Lignites, Hill; Ann'l Rep't Geol. Surv. Ark., 1888. vol. 2, p. 188.

Lower Eocene or Lignitic series, partim, Spencer; Geol. Surv. Ga., 1st Rep't, p. 43, 1891.

Lower Tertiary, partim, Conrad; Proc. Nat. Inst., 2d Bull., p. 179, 1841.

Manchester shales, Hill; Ann'l Rep't Geol. Surv. Ark., 1888, vol. 2, p. 188.

Miocene, L. Harper; Prelim. Rep't Geol. and Agr. Miss., 1857.

Nanafalia group, Smith and Aldrich; Bull. 1, Geol. Surv. Ala. p. 58, 1886.

Nanafalia, Smith and Johnson; Bull. 43, U. S. Geol. Surv., pp. 18 and 51, 1887.

Nanafalia, Langdon; Bull. Amer. Geol. Soc., vol. 2, p. 596, 1891.

Northern Lignitic group, (exclusive of the "Post Oak Flatwoods"), Hilgard; Rep't Geol. and Agr. Miss., 1860, vol. 1, p. 110.

Orange sand or Lagrange group, Safford; Geol. of Tenn., 1869, p. 424.

Secondary rocks, partim, Maclure; Trans. Amer. Philos. Soc., vol. 6, map, 1809; vol. 1. New series, map.

Timber belt or Sabine river beds, partim, Penrose; Ann'l Rep't Geol. Surv. Tex., vol. 1, 1889, p. 22.

Tuscahoma, Langdon; Bull. Amer. Geol. Soc., vol. 2, p. 596, 1891.

Woods bluff group, Smith and Aldrich; Bull., Geol. Surv. Ala., p. 51, 1886.

Woods bluff, Smith and Johnson; Bull. 43, U. S. Geol. Surv., pp. 18 and 43, 1887.

* * *

SECTION II. PALEONTOLOGY.

OSTREA.

Ostrea compressirostra, Pl. 1, 2, 3; and pl. 6, fig. 1, (2?)

Syn. *O. compressirostra* Say, Jour. Acad. Nat. Sci. Phila., vol. 4, p. 132. pl. 8 fig. 2.
O. bellovacina Con., Proc. Nat. Inst., 1842, p. 172.
O.,compressirostra (Tuomey) Thornton, 2d Bien'l &c., p. 270, 1858.
O. bellovacina Con., non Lam., Con., Amer. Jour. Conch., vol. 1, p. 15, 1865.
O. compressirostra Heilprin, 3d Ann' Rep't U. S. G. S., p. 309, pl. 65, 1884.
O. compressirostra Ald., Bull. 1, Geol. Surv. Ala., p. 57, 1886.
O. compressirostra Langdon, Bull. Geol. Soc. Amer., vol. 2 p. 603, 1890.
O. compressirostra Har., Amer. Jour. Sci., 3d ser. vol. 47, p. 302, 1894.
O. compressirostra Say, Bull. Amer. Paleont., vol. 1, p. 308, pl. 27, fig. 2, 1846.

Say's original description.—(See Bull. Amer. Paleont., vol. 1, p. 308.)

Plate 1 shows the original figure of the species. It represents a very common though not a well developed phase of the species. Plates 2 and 3 represent different views of an uncommonly well developed and well preserved specimen.

Say, Conrad, Heilprin and others have noted the strong resemblance which this species bears to *O. bellovacina* of the Old World. To any American, collecting at the type locality of the latter species, near Beauvais (Butte de la Justice), the resemblance between the *Ostreæ*, *Crassatellæ* &c., found there and those found in the lower Lignitic beds of his own conntry, seems most striking. But by comparing these representative species side by side certain differences are sure to be brought out. The plication on the outer surface of *compressirostra* is loose, uneven, and sometimes not well defined, while in *bellovacina* it is comparatively sharp and well defined. It is well represented in Deshayes' Description des Coquilles Fossiles des Environs de Paris, pl. 48, fig's 1, 2; pl. 49, fig's 1, 2; pl, 50, fig. 6. The muscular impression is reniform and not pyriform as in *compressirostra*; there is a lack of anterior alation in the larger valve, and the dehiscence or marginal flexture is lower down on the posterior margin. Searles V. Wood, in his monograph of the Eocene mollusca &c. published by the Paleontographical Society, 1861, says, p. 18, regarding a specimen brought from the New World by Charles Lyell: "I have seen a specimen, in Sir Charles' cabinet, from Virginia, (without a name), which, in some characters resembles *O. pulchra;* I can scarcely think it strictly identical either with it, or with *bellovacina.*"

Heilprin has already called attention to the fact (3d Ann'l Rep't U. S. Geol. Surv., p. 310) that the species from "Grove," S. C., referred by Lyell to *O. bellovacina* (Proc. Geol. Soc. Lond., Feb. 1845, p. 567) should probably have been referred to *O. carolinensis* Con. We have already shown (Bull. Amer. Paleont., vol. 1, p. 159, 1896) that certain specimens referred to this species by Langdon, are really another species, called first by Gabb., *O. crenulimarginata.* Below we will show how others from the upper Lignitic should be classed as a third species, *O.* var. *sylværupis.*

This species is extremely abundant and often of large dimensions at Bell's Landing and Ft. Gaines.

Localities (exclusive of Md. and Va.).—Alabama: Nanafalia, Tuscahoma, Yellow Bluff, Gregg's Landing, Bell's Landing. Georgia: Ft Gaines.

Ostrea trigonalis var. **sylværupis,** Pl's 4 and 5. Pl. 6, figs. 3, a, 4.

Syn. *O. compressirostra* Tuomey, 1st Bien. Rep't, p. 146, 1850.
O. carolinensis Con., Amer. Jour. Sci., vol. 40, p. 266, 1865.
O. probably young of *thirsæ* Gabb, Ald., Bull. 1, Geol. Surv. Ala., 1886.
O. compressirostra Smith and Johnson, Bull. 43, U. S. Geol Surv. p. 44, 1887.

It is in deference to Dall's opinion that this form is referred to as a variety of *trigonalis* Con., Proc. Acad. Nat. Sci. Phila., 1855, p. 259, and Wailes' Agr. and Geol. Miss., 1854, pl. 14, fig. 10. We have here but a half dozen rather imperfect specimens of *trigonalis* while at the National museum, the material from the Jackson beds is far more satisfactory. Our specimens of *trigonalis* are not so quadrangular nor so incrassated as *sylværupis.* The more important features of the latter are as follows:

Quadrangular or broadly oval in outline; valves very thick and of a silicious granular texture: left valve very convex and heavy; exterior sometimes marked by faint and irregular costations; interior showing a moderately deep ligamental pit with small lateral areas, an elliptical-circular muscular scar situated very near the center of the valve, a slight dehiscence anteriorly, and a stronger one posteriorly, and profound depression central-posteriorly for the soft parts; right valve operculate, somewhat sinuate anteriorly and posteriorly to partially or wholly counteract the gaping tendency of the left valve; ligamental pit not deep, but well defined, with moderate lateral areas; muscular impression elliptical-circular; greatest thickness just within the periphery.

This form has for some time been a source of annoyance to the writer, for it certainly has characters in common with *O. compressirostra*, *O. carolinensis*, *O. trigonalis*, and *O. sellæformis*. It is from the Lignitic horizon, hence in *O. compressirostra* one would expect its closest ally. It differs, however, from *O. compressirostra* by its circular-quadrate form, incrassated valves, circular muscular impression, paucity of ribs in adult form, and entire want of the same during earlier stages of growth.

This species is doubtless the one referred to by Tuomey in his 1st Biennial Report, p. 146, for he says the shells are large and ponderous and resemble very closely a variety of *O. compressirostra* found on Santee canal, South Carolina. This statement evidently led Conrad to supppose, Amer. Jour. Sci., 2d ser., vol. 40, p. 266, 1865, that this oyster was really *O. carolinensis* described by himself in 1832, Foss. Shells, Tert. Form, p. 27, pl. 14, and he makes this amendment in Tuomey's list. Heilprin, however, states that in the copy of Tuomey's report in the Philadelphia Academy the following is written in pencil *a propos* of Tuomey's list : " All doubtful except *Venericardia planicosta*. T. A. Conrad." Heilprin does not specifically identify the oysters contained in the collections he studied and reported upon from Knight's and Cave Branches and Woods Bluff for Dr. E. A. Smith, Proc. Acad. Nat. Sci., 1880 pp. 364–366; nor does Aldrich give specific names to these forms in Bulletin No. 1 of the Alabama Survey, 1886. The young form here shown pl. 6, figs. 3, 4, he doubtless refers to as "Ostrea (probably *O. thirsæ*)"

Smith and Johnson, however, in Bull. 43, U. S. Geol.Surv., p. 44, 1887, designate this oyster as "*O. compressirostra* Say, with very thick and ponderous shells."

True it is we may yet doubt whether the numerous thin young oysters, found for example, in the upper part of the Woods bluff outcrop, are the representatives of the full grown specimens in the concretionary layers below. Yet we have seen an approach to this young state made by *O. compressirostra* and *O. crenulimarginata*, though in these there is generally at least some trace of ribbing, and the muscular scar is heart-shaped as in the adults.

Pl. 6, fig's 3, 4, represent what we regard as the young of this species. Pl. 6, fig. 1, is a young *O. compressirostra*. That these are not Gabb's *Gryphæa thirsæ* is evident from the marked differences shown in thickness, obliquity, form of muscular scars, and above all by differences in direction of lines of growth.

Localities.—Alabama: Woods Bluff; three miles southwest of Thomasville; near the mouth of Bashi creek. It may be expected wherever Woods Bluff beds crop out.

Ostrea thirsæ, Pl. 6, figs. 5, 6.

Syn. *O. emarginata* Tuomey, (name only) 2d Biennial Rep't Geol. of Ala., 1858, p. 269.
Gryphæa thirsæ Gabb, Proc. Acad. Nat. Sci. Phila., 1861, p. 329.
Ostrea thirsæ Heilprin, 3d Ann'l Rep't U. S. Geol. Surv., p. 311, pl. 63, fig's 4, 5, 6.
Gryphæa thirsæ Aldrich, Bull. 1, Geol. Surv. Ala., p. 58, 1886.

Gabb's original description.—"Rounded sub-trinangular. Lower valve; beak very small, and close to the hinge, nerver exsert Umbone rounded, very prominent and somewhat compressed laterally, the rounded elevation continuing more or less regularly, becoming broader, to the middle of the basal margin, at which point this margin is always somewhat emarginate. Ligament area broad, triangular, transversely striate, and with a slight irregular depression in the middle. Interior of valve very deep. Muscular impression nearly ovoid, narrowest on the inner end. External surface marked by a few small, irregular squamose ridges, most numerous and distinct directly behind the emargination of the base. Upper valve unknown.

"The species resembles, remotely, some of the narrower forms of *G. vesicularis* Lam., but after comparing the series before me with numerous authentic specimens of that species, both American and European, some of the latter labelled by d'Orbigny and others, by Charlesworth, I am satisfied that they are distinct. The beak is so small as to be almost obsolete, and there is always a more or less distinct, rounded, umbonal ridge. In general form, it resembles *G.* (*Exogyra*) *columba*, but wants the spiral beak, and is never lobed. The small beak and absence of all traces of lobes will sufficiently separate it from *G. pitcherii.*

"The specimens are in the Museum of the Smithsonian Institute (No. 570), and are from a light gray sandy marl.

"*Locality.*—'Nanafalia,' Alabama.

"Length, 1.7 in. Greatest width, 1.3 in. Width at the hinge, .6 in. Greatest height of valve, .8 in. Height at the hinge, .7 in. Length from the basal margin, over the umbone, to the beak, 2.3 in."

Localities.—Alabama: R. R. cuts 1-2 mile north of Pine Hill; Nanafalia; Gullette's Landing; Bell's Landing (scarce); Smith and Johnson report this species as abundant in Grampian Hills, south of Camden. Langdon reports it from Conecuh River, Sect. 21, T. 8, R. 19, E., and from Chattahoochee, between Ft. Gaines, Ga. and Wood's shoals.

Ostrea alabamiensis Lea. Pl. 6, fig. 7.

A few fragments were found at Hatchetigbee bluff that seem to belong to this species. The discussion of the species will more properly come in a future Bulletin on the Lower Claiborne stage.

Ostrea sellæformis Con. Pl. 6, fig. 2.

Aldrich has identified this species from Hatchetigbee bluff, Bull. Geol. Surv. Ala., p. 50 1886, and we have a few small and ill preserved specimens perhaps belonging to this species from the same locality, and 4 miles above Hamilton Bluff, on the Alabama, yet the identification is doubtful and the species had best be considered under the Lower Claiborne stage.

Plicatula filamentosa, var. Pl. 6, figs. 8, 9.

Syn. *P. filamentosa* Con., Foss. Sh. Tert. Form., Aug. 1833, p. 38.
P. mantelli Lea., Cont. to Geol., Dec. 1833, p. 89, pl. 3, fig. 68.
P. filamentosa Ald., Bull. 1, Geol. Surv. Ala., p. 50, 1886.

Conrad's original description.—"Shell suborbicular, narrowing toward the apex, much compressed; with seven costæ; and densely imbricated with small, irregular, concentric wrinkles, and with minute radiating lines. Breadth and length about ¾ of an inch.

"*Locality.*—Claiborne, Ala. Cab. Acad. N. S."

The variety in question differs from the typical Claiborne specimens by having 10 or 15 costæ and by its much smaller size. Yet there seem to be intermediate stages, and for the present it will be assumed that environment has caused the difference in the appearance of the two forms.

Localities (of this type).—Alabama: Hatchetigbee Bluff; 4 miles above Hamilton Bluff, Alabama River; Ozark, R. R. cut just below the Buhrstone.

ANOMIA.

Anomia, sp. Pl. 6, fig. 10.

Two very young specimens of this genus, one of which is herewith figured, were found at Hatchetigbee bluff. It seems inadvisable to attempt a specific characterization of such immature forms. However, one feature deserves special attention, viz. the peculiar grooves converging posterior to the muscular impressions and terminating in circular shallow depressions or pits. See figure.

Spondylus, sp. Pl. 6, fig. 11.

Syn. *Plagiostoma dumosum* Con., Foss. Sh. Tert. Form, 1835, p. 34.
Spondylus dumosus Ald., Amer. Jour. Sci., 3rd ser., vol. 30, p. 305, 1885.
Spondylns dumosus var. Ald., Bull. 1, Geol. Surv. Ala., p. 50, 1886.

We feel great hesitation in placing this upper Lignitic form in with Morton's *P. dumosum*. For his description (Synop. Org. Rem. Cret. G'p.,p. 59, 1834) argees exactly with well preserved specimens from Chickasawhay and other Vicksburgian localities, but it does not agree so well with the specimens now under consideration. Morton very properly remarks that *dumosum* has spines on both valves. Our specimen figured has none. Another smaller specimen of a right valve does show spines, but they are much finer and aciculate, the spine-bearing and intermediate costæ are more numerous than in *dumosus*. Again, the valves appear more oblique.

This subject will be discussed more fully in a future work on the Vicksburg stage.

Localities.—Alabama: Hatchetigbee Bluff; Ozark, R. R. cut just beneath the Buhrstone.

Specimen figured.—From Hatchetigbee Bluff, in Cornell University collection.

Lima ozarkana, n. sp. Pl. 6. fig. 12.

Specific characterization.—General form and size as indicated by the figure ; ventricose; ligamental pit very broad, occupying a greater part of the hinge plateau ; surface marked by 25 or 30 sharply defined radiating raised lines, between which are secondary and sometimes tertiary systems of lines.

Locality.—Alabama : Ozark, R. R. cut, just beneath the Buhrstone.

Type figured.—From Ozark, Ala.; Collection of Paleont. Mus. Cornell University.

Pseudamussium claibornense, Pl. 7, fig. 1.

Syn. *P. claibornensis* Con., label, Phila. Acad. Museum.
Camptonectes claibornensis Con., Smithsonian Check List.
Pecten claibornensis Heilprin, Proc. Acad. Nat. Sci. Phila., 1881, p. 416.
Pecten claibornensis Har., Geol. Surv. Ark., Rep't 1892, vol. ii, p. 145.
Pecten claibornensis Har. Proc. Acad. Nat. Sci. Phila., 1896, p. 470, pl. 18 fig's 1 and 2.

It is quite possible that the little *P. scintillatus* figured and described by Conrad (Amer. Jour. Conch., 1865, p. 140, pl. 10, fig. 4.) is but a young or dwarfed specimen of this species. *P. claibornensis* has never been fully characterized, but was referred to by the writer in his Arkansas Report as follows : "This rather small, thin *Pecten* appearing smooth to the naked eye, when examined under a microscope is found to contain minute ex-curving radiate lines, especially near the anterior and posterior margins. It is fairly abundant at Moody's branch, near Jackson, Mississippi."

The specimens now under consideration are somewhat larger than those from Moody's branch, but there seems to be no valid reason for regarding the two forms as specifically distinct.

The resemblance of this species to *P. calvatus* Mort. is of course noticeable as Heilprin and others have observed, but if we mistake not, that species does show freqently well defined costæ, this is always smooth both within and without.

European representative.—*P. corneus* Sby.,Min. Conch.,pl. 204.

Locality (Lignitic).—Alabama : Hatchetigbee Bluff.

Specimens figured.— Hatchetigbee Bluff, Paleont. Museum of Cornell University.

AMUSSIUM.

Amussium squamulum, Pl. 7, figs. 2, a. 3.

Syn. *P. squamula* Lam., Ann. du Mus., vol. 8, p. 354, No. 3.
Lam., An. sans Vert., vol. 6, p. 183, 1819.
Desh., Coq. Foss. Env. Par., p. 304, pl. 45, fig's 16, 17, 18.
Dixon, Geol. Sussex, 1850, pp. 94–172, pl. 3, fig. 29.
Desh., Descr. des An. Sans. Vert., 1864, vol. 2, p. 74.

We have not had access to Lamarck's original description, but in his An. sans Vert., *l. c.* he says simply "*P. testa minimi, orbiculari, intus subocto-radiata.*" Deshayes, however, remarks p. 304, op. cit. "Cette coquille est la plus petite du genre; elle est arrondie, lenticulaire, très-déprimée, équivalve, équilatérale, à oreillettes égales, toute lisse en dehors et, comme le *Pecten pleuronectes*, ornée en dedans de côtes saillantes régulières et rayonnantes du summit à la base. Ces côtes sont étroites, égales, distantes, et elles varient dans les individus de huit à dix. La charnière est droite, linéaire, simple ; les oreillettes qui la prolongent sont égales un peu obtuses, semblables sur les deux valves, si ce n'est l'antérieure de la valve droite, qui est échancrée assez profondément à la base. Ces oreillettes sont grandes relativement à la taille de la coquille. Cette espèce, assez rare n'a que quatre à cinq millimètres de diamètre."

Again (Descr. An. sans Vert., p. 74) Deshayes says : "Cette petite espèce est peu commune. Elle apparaît dans cette partie des sables inférieurs qui se superpose aux lignites, et elle vient s'éteindre dans le calcaire grossier moyen. Elle est assez variable ; les côtes intérieures sont le plus ordinairement au nombre de huit, mais elles varient de sept à onze. Dans les individus d'Aizy et de Laon, qui sont aussi les plus grands, les côtes intérieures sont souvent d'un brun noirâtre, ce qui les rend plus apparentes. Dans les individus les plus frais, la surface extérieure, recouverte d'une mince couche corticale subcornée, est d'un gris peu foncé.

"Nos plus grands individus ont jusqu'à 9 millimètres de diamèter."

"*Localités.*—Aizy, Laon, Chaumont, Brasles, Fontenay—Saint-Père, Parnes."

Although Deshayes says the interior ribs extend "du summit à la base," the figures in Dixon's work show that such is not always the case, they neither reach the base nor the umbonal region. Dixon gives no description but his figures indicate some slight external striation and color patches.

In general we feel great hesitation in assigning specimens from both sides of the Atlantic to the same species. But in this case Dixon's figures represent the American form so precisely that it would seem absurd to propose for it a new name. That Aldrich's *Pecten alabamensis* is a precursor of this and should be reckoned as a subspecies only, will probably be shown hereafter. The main points of difference between this and *A. alabamense* are: 1st. In *squamulum* from Woods bluff there are normally 9 ribs, exceptions are rare; the exterior of *squamulum* is smooth except sometimes the left valve is finely striate radially; the right valve of *alabamense* is finely, sharply, striate concentrically and is superimposed generally by very strong, sharply defined raised lines or costæ which cause nodulations at their intersection with the stronger concentric lines; the curvature of the valves of *alabamense* is uniform; in *squamulum* there is a slight flattening anteriorly and posteriorly just below the umbonal ridge, and there are yellowish color patches scattered about over the left valve. Cossmann has with propriety referred Lamarck's *P. squamula* to *Amussium* (Extr. Ann. Soc. Roy. Mal. de Belg., vol. xxxi, 1896, App. 2, p. 63). It is slightly gaping fore and aft, has strong interior ribs, is practically smooth exteriorly, and has internally slight projections on the lower portions of the ridges formed by the ears. It may be observed, however, that the ears of this species are rather large for *Amussium* and that there is a decided slit beneath the anterior ear of the right valve for the passage of a byssus. This feature together with the strong markings of *A. alabamense* Ald. show that the limits of the genus *Amussium* must be somewhat enlarged.

Locality.—Alabama: Woods Bluff.

Specimens figured.—Woods Bluff. Paleont. Mus., Cornell University.

Chlamys greggi, n. sp. Pl. 7, figs. 4, 5.

Syn. *? P. deshayeii* Ald., Bull. No. 1, Geol. Surv. Ala., p. 57, 1886.

Specific characteristics.—General appearance as figured; exterior with about 25 to 30 strong, smooth, sharply defined ribs radiating from the beak without bifurcation, ears with 5 or 6 radiating folds or costæ; interspaces about twice the breadth of the ribs, anteriorly and posteriorly showing the microscopic ex-curving striæ of *Camptonectes*

This species is of nearly the form and size of *C. choctavensis*, from which it is distinguished by its small number of ribs, its lack of costal bifurcation and imbrication, and the presence of *Camptonectes* structure in the interspaces.

Right valves of this species are somewhat gibbous.

Localities.—Alabama : Yellow Bluff; Gregg's Landing; Bell's Landing; Lower Peach Tree Landing. Georgia : Ft. Gaines.

Type.—Gregg's Landing, Harris' collection.

Chlamys choctavensis, Pl. 7, fig. 6.

Syn. *P. choctavensis* Ald., Bull. Amer. Paleont., vol.i,p. 68, pl. 6, fig. 7, 1895.

Aldrich's original description.—Loco citato.

Localities.—Alabama : Choctaw Corner and Woods bluff.

Specimen figured.—Woods Bluff ; Paleont. Museum, Cornell University.

Avicula, sp. Pl. 7, fig. 7, a.

Syn. *A. limula* Ald., Bull. 1, Geol. Surv. Ala., p. 54, 1886.

It is quite possible that this is *A. limula* Con., but its state of preservation is not sufficient to warrant specific identification.

Locality.—Alabama : Woods Bluff.

Specimen figured.—Paleont. Museum, Cornell University.

Pinna, sp. Pl. 7, fig. 8.

Syn. *Pinna* sp. Ald., Bull. 1, Geol. Surv. Ala., p. 54, 1886.

It is difficult to give the dimensions of this species though the general form can be made out from the fragmentary specimen figured. The markings on the upper moiety of the valve resemble those of *P. argentea* Con., but the lower portion does not show the rugose lines of that species. This resembles more closely the Miocene form from Patuxent River, Md.

Locality.—Alabama : Woods Bluff.

Specimen figured.—Woods Bluff ; Paleont. Museum, Cornell University.

Modiola alabamensis, Pl. 7, fig. 9.

Syn. *M. alabamensis* Ald., Bull. Amer. Paleont., vol. i, p. 68, pl. 6, fig. 13.

Aldrich's original description.—Op. cit.

The original specimen shows no radiate marking beneath a line drawn from the umbo to the posterior basal margin, except at the extreme anterior. Our specimen, a right valve shows not only the markings of the type but also fine radii where the latter is smooth.

Localities.—Alabama: Woods Bluff; Choctaw Corner.

Type.—Choctaw Corner; Aldrich's collection.

Specimen figured.—Woods Bluff; Paleont. Museum, Cornell University.

Arca hatchetigbeensis, n. sp. Pl. 7, fig. 10, a.

Syn. *Arca subprotracta* Ald., Bull. 1, Geol. Surv. Ala., p. 50, 1886.

Specific characterization.—Size and general form as indicated by the figure; surface covered by well defined but somewhat irregular imbricate concentric lines, crossed by raised radiating fine costæ; young shell not extremely elongate, with surface marking of equal strength everywhere; in adults the medial sinus becomes more pronounced, the radiating ribs before the sinus being stronger than those behind the same, and the shell is more or less distorted.

This species differs from *protracta* Con.—*subprotractra* Heilp. by its much less elongate form, broader anterior, the presence of two particularly strong costæ located medially on the post-umbonal slope. By examining the type specimen of *A. protractra* in the Academy's collection at Philadelphia, it will be seen that it agrees somewhat more nearly with this species than would be supposed from Conrad's figure, yet the agreement can scarcely constitute specific identity.

Locality (Lignitic).—Alabama: Hatchetigbee.

Type.—Hatchetigbee; Paleont. Museum, Cornell University.

Barbatia cuculloides, var. Pl. 8, fig. 1, a.

Syn. *Arca cuculloides* Con., Foss. Shells, Tert. Form, p. 37, 1883.
Arca lima var. Ald., Bull. 1, Geol. Surv. Ala., p. 57, 1886.
Arca sp. Harris, Bull. Amer. Paleont., vol. 1, p. 164, pl. 13, figs. 8, 6, 9, a., 1896.

Conrad's original description.—"Shell compressed, thick, inequivalve, reticulated; with a broad subcentral sinus, passing from the beak to the basal margin; posterior side elongated, strongly ribbed, and carinated; anterior side with numerous striæ; anterior end truncated. Length 2¼ inches. Breadth 1½ inches.

"The hinge of this shell approaches *Cucullæa* in the interval between the beaks, having arcuated grooves under the beak; line of series of hinge teeth widely interrupted, and transverse at the extremities." Locality; Claiborne, Alabama.

The variety has a somewhat more pointed posterior basal angle and has somewhat more sharply defined sculpturing than the type specimen, especially on the post-umbonal slope. Yet they seem scarcely distinct specifically.

Type.—Academy Natural Sciences, Philadelphia.

Localities (Lignitic).—Alabama: Gregg's Landing. Bell's Landing,—Aldrich. Georgia: Ft. Gaines, ledge 50 feet below top of cliff, i.e. bed 8; see. p. 33.

Specimen figured.—Gregg's Landing. Paleont. Museum, Cornell University.

Trigonarca pulchra, var. Pl. 8, figs. 2, a.

Syn. *Nœtia pulchra* Gabb. Jr., Acad. Nat. Sci. Phila., vol. 4, p. 388, pl. 67, fig. 55, 1860.
Limopsis pulchra Heilp., Proc. Acad. Nat. Sci., 1890, p. 403.

Gabb's original description.—"Subquadrangular; beaks small, incurved; umbonal slope nearly straight; anterior margin rounded, basal arcuate; posterior subangular; surface marked by numerous radiating and transverse lines; edge crenate within; posterior muscular scar subtriangular, anterior subrhomboidal.

"*Dimensions.*—Length .27 in., width .35 in."

The variety in hand is much smaller than the typical specimen from Texas and the radiating lines are far less distinct; yet the general form is the same—quite unlike the Claiborne and Lower Claiborne species of Alabama.

Lignitic Locality.—Alabama: Woods Bluff, Hatchetigbee.

Specimen figured.—Woods Bluff; Paleont. Museum, Cornell University.

Cucullæa gigantea, var. Pl. 8, figs. 3, a. 4.

Syn. *C. transversa* Ald., Bull. 1, Geol. Surv. Ala., p. 40, pl. 4, figs. 11, 11a, and p. 57, 1886.
C. transversa Har., Amer. Jour. Sci., vol. 47, p. 302, 1894.

The original description of *C. gigantea* Con., in the Jour. Acad. Nat. Sci. Phila., vol. vi, p. 227, pl. 10 fig. 4, 1830, was drawn from the very imperfectly preserved large casts in the vicinity of Ft. Washington, Md. and hence gives but little definite knowledge regarding the specific features of this fossil. For the sake of completeness however, the description is here repeated.

Conrad's original description.—"Shell subtriangular, obliquely cordate; very ventricose, with numerous longitudinal sulci; anterior side flattened, produced and subcuneiform; posterior side very short; umbones gibbous; beaks distant, and much incurved.

"Three and three-quarters inches in length; and five and a quarter inches in breadth." "Cabinet of the Academy."

Early in 1894 the writer pointed out the probable equivalency of the Alabama forms with the *C. gigantea.* Sufficient material however, was not at hand to warrant uniting them without reserve. During last summer's work along the Rappahannock and Potomac this species was specially sought after; and by examining the collections with some care it is apparent that there is but one species of *Cucullæa* in the Virginia Eocene, i.e. that *gigantea*, *ononchela*, *idonea*, and *transversa* are in all probability the same.

This southern form which for various reasons Aldrich and the writer have referred to *transversa* does vary somewhat from the Virginia specimens, but scarcely enough to call another species.

This matter will be more carefully discussed in a future publication on the Eocene of Maryland and Virginia.

Localities. — Alabama: Gregg's Landing, Bell's Landing.
Georgia: Ft. Gaines, bed 8; see. p. 33.

Type.—Academy Natural Sciences, Philadelphia.

Specimens figured.—Gregg's Landing, Harris' collection.

Pectunculus idoneus, Pl. 8, figs. 5, a. 6.

Syn. *P. idoneus* Con., Foss. Sh., Tert. Form, p. 39, 1833.
Pectunculus (n. sp.) Tuomey, 2d Biennial Rep't, p. 271, 1858.

P. stamineus Ald., Bull. 1, Geol. Surv. Ala., pp. 50, 53, 57, 58, 1886.
Pectunculus sp., Harris, Bull. Amer. Paleont., vol. 1, p. 167.

Conrad's original description.—"Shell suborbicular, thick, convex; oblique, with rather obscure radiating striæ, and minute intervening lines; umbo convex, beaks distant, rather prominent and pointed; cardinal teeth large; truncated in the center by a rectilinear line; cavity capacious; margin crenate. Length 1¼ in." Conrad's specimen was from Claiborne, Ala.

Grave doubt is felt as to the exact equivalency of all the Lignitic specimens with this species. Yet there seem to be no fixed or constant differences upon which to found a new species.

Localities. — Alabama: Nanafalia; Tuscahoma Landing; Hatchetigbee; Gregg's Landing; Bell's Landing, four miles above Hamilton Bluff. Georgia: Ft. Gaines; bed 8, p. 33.

Type.—Academy Natural Sciences, Philadelphia.

Specimens figured.—Fig. 5, Yellow Bluff; C. U. collection. Fig. 6, Gregg's Landing; Harris' collection.

Nucula ovula, Pl. 8, fig. 7.

Syn. See vol. 1, Bull. Amer. Paleont., p. 168.

Localities.—Alabama: Woods Bluff; Nanafalia; Gregg's Landing; Choctaw Corner; four miles above Hamilton Bluff, Alabama River.

Specimen figured.—Woods Bluff; Paleont. Museum, Cornell University

Nucula magnifica Con.

Aldrich reports this species from Bell's and Gregg's landings, Alabama, but our collections contain no specimens from these or other Lignitic localities.

Leda elongatoidea, Pl. 8, figs. 8, 9.

Syn. *L. elongatoidea* Ald., Bull. Amer. Paleont., vol. i, p. 69, pl. 6, fig. 2, 1895.
Non L. elongatoidea? Har., Bull. Amer. Paleont., vol. i, p. 169, pl. 14, fig. 10.

Aldrich's original description. Op. cit. p. 69.

Aldrich's type specimen is slightly broken anteriorly and posteriorly, but agrees well with the specimens in our collections. Among the latter however, several specimens show a few high concentric lines about the umbo.

Fig 9 is a strangely elongated variety from Gregg's landing, it presents no essential varietal features however, except its extreme posterior prolongation.

Localities. — Alabama : Butler ; Woods Bluff ; Nanafalia ; Ozark.

Type.—Aldrich's collection.

Specimen figured.— Paleontological Museum, Cornell University.

Leda corpulentoides, var's. Pl. 8, figs. 10, 11.

Syn. *Yoldia corpulentoides* Ald., Bull. Amer. Paleont., vol. i, p. 70, figs. 9, 9a., 1895.

Aldrich's original description.—Op. cit. p. 70.

Mr. Aldrich very kindly sent us several duplicate specimens of *corpulentoides* from Tuscahoma, but they are all in a very imperfect state of preservation. Our own collections contain the specimens figured, presumably belonging to this species. Fig. 10 is from Gregg's landing, is quite tumid centrally and is almost devoid of surface sculpture except traces of fine concentric lines. It is, however, accompanied by younger forms showing stronger concentric lines centrally, which diminish in strength anteriorly and which when arriving at about the longitude of the posterior channel in Fig. 11, suddenly terminate in a slightly enlarged granule ; this feature is clearly noticeable near the beaks only. The *corpulentoides* from Tuscahoma are all adults, and are somewhat stouter than the Gregg's landing specimens, but it seems probable that all will eventually prove to be identical.

Fig. 11 is from Nanafalia and agrees fairly well with *corpulentoides*, except the channel just anterior to the umbonal slope is very deep, the concentric lines are coarser, and the general form of the shell is somewhat less inflated than *elongatoides*.

Type.—Aldrich's collection.

Specimens figured. — Paleontological Museum, Cornell University.

Leda marieana. Pl. 8, fig. 12.

Syn. *L. marieana* Ald., Bull. Amer. Paleont., vol. ii, p. 182, pl. 6, fig. 5.

For Aldrich's original description, *op. cit.*

Without the type specimen before us we are very much inclined to regard this as the young of fig. 13, pl. 8.

Localities.—Alabama: Choctaw Corner.

Type.—Aldrich's collection.

Leda protexta. Pl. 8, fig. 13.

Syn. *Nuculana protexta* Con., Amer. Jour. Conch., vol. i, 1865, p. 147, pl. 11, fig. 6.
Leda protexta Heilp., Proc. Acad. Nat. Sci. Phila., 1880, p. 365.
Leda protexta Ald., Bull. 1, Geol. Surv. Ala., pp. 50, 53, 57, 1886.

Conrad's original description. — "Elongated, slightly ventricose, with closely arranged, minute thread-like concentric lines, distinct and rugose on the anterior submargin, which is flattened, or broadly and slightly furrowed. Upper margin oblique, medially rectilinear, reflexed at the end; posterior extremity above the middle and on a line with the anterior end; posterior ventral margin obliquely truncated.

"*Locality.*—Alabama. Dr. Showalter."

This species shows considerable variation in outline and surface ornamentation. Older Lignitic specimens, from Gregg's landing show finer striæ and less sharply defined post-umbonal slope.

We are well aware that Gnbb gave the name *protexta* to a species (*L. protexta* Gabb, Jour. Acad. Nat. Sci., Phila., vol. iv, 1860, p. 303) five years before Conrad named this form. Since Mr. Stanton, our best authority on invertebrate Cretaceous paleontology, writes that Gabb's species just referred to is a true *Leda*, it follows as a matter of course that the same specific name cannot be permanently retained for the Lignitic form under discussion.

The indications are however, that when all the Eocene stages have been carefully gone over, this *L. protexta* Con. will prove but an ancestral form of a species named by Conrad himself several years before 1865. Hence, feeling that the name *protexta* is doing less harm in Tertiary literature than a new and perhaps unnecessary name might do, the latter is avoided for the present.

Localities.—Alabama: Woods Bluff; four miles above Hamilton Bluff, Alabama River; Ozark; Gregg's Landing. Georgia: Ft. Gaines.

Type.—Acad. Nat. Sci., Phila.; improperly labelled by Heilprin "Claiborne, Ala."

Leda parva, Pl. 8, fig. 14.

Syn. *Nucula parva* Rogers, Trans. Amer. Philos. Soc,, vol. v, p. 340, 1838.
Leda n. sp. Ald., Bull. 1, Geol. Surv. Ala., p. 53, 1886.
Leda robusta Ald., Bull. Amer. Paleont., vol. i, p. 69, pl. 6, figs. 1, 1a.

Rogers' original description.—"Shell ovate, inflated, rounded before, not much produced, but rapidly tapering to a truncated point behind, furnished with about twelve rather coarse concentric folds or ridges, and a longitudinal gently depressed groove or undulation of surface, running from near the beak to near the posterior basal margin; beaks nearly central; anterior series of teeth slightly arched; posterior series nearly straight; margin entire; cavity rather deep. Length, three-twentieths; height, two-twentieths of an inch." Coggin's Pt., Pr. Geo. Co., Va.

This species shows great variation as regards size and surface ornamentation. The specimen figured by Aldrich (*loc. cit.*) represents a marked variety showing very few concentric plications. At Gregg's landing a somewhat larger form occurs, showing not the broad concentric folds of Aldrich's figure, but a great many rounded, concentric lines. This in turn is preceded by the form styled by us last year, *Leda quercollis* (Bull. Amer. Paleont., vol. 1, p. 169.)

Specimens from Evergreen, Va., show characters precisely like the smaller, less robust specimens from Woods bluff.

Localities (Gulf States).—Alabama: Woods Bluff; 1¼ miles w. s. w. of Choctaw Corner; Gregg's Landing; 4 miles above Hamilton Bluff, Alabama River.

Type.—

Specimen figured.—Woods Bluff; Paleont. Museum, Cornell University.

Yoldia aldrichiana, Pl. 8, fig. 15.

Syn. *Leda elongatoidea?* Har. (non Ald.,) Bull. Amer. Paleont., vol. i, pl. 14, fig. 10.

Aldrich's *elongatoidea* having proven quite a different shell, we venture to describe this species as new.

Specific characterization.—Size and general form as indicated by the figure; anterior sub-basal margin tending to become rectilinear; shell rather thin and *Yoldia*-like, transversed exteriorly by very minute concentric lines on the median portion, dying away anteriorly and posteriorly ; anterior series of teeth slightly curved; posterior series nearly rectilinear causing the margin of the shell half way from beak to posterior extremity to be slightly elevated ; pallial sinus deep ; a slightly depressed area extending from the beak to the posterior basal and superior margin.

The Midway specimens are varietally distinct from the Lignitic.

Localities.—Alabama : Woods Bluff.

Type.—Woods Bluff ; Paleont. Museum, Cornell University.

Venericardia planicosta, Pl's. 9, & 10.

Syn. See Bull. Amer. Paleont., vol. i, p. 172; add:—
Cardita densata Con., Jour. Acad. Nat. Sci. Phila., vol. i, p. 130, pl. 14, fig. 24, 1848.
Cardita planicosta Tuomey, 1st Biennial Rep't Geol. Ala., pp. 146–147, 1850.
Cardita planicosta Tuomey, 2d Biennial Rep't Geol. Ala., p. 270, 1858.
Venericardia planicosta Con. (Heilp.), Proc. Acad. Nat. Sci., Phila., 1880, p. 366, foot-note.
Venericardia planicosta Ald., Bull. 1, Geol. Surv. Ala., pp. 50, 53, 55, 57, & 58, 1886.
Venericardia planicosta Smith & Johnson, Bull. 43, U. S. Geol. Surv., pp. 40, 44, 45, 50, & 51, 1887.

Lamarck's original description. — See Bull. Amer. Paleont., vol. i, p. 172, 1896.

It has already been shown how great are the variations of this species in the oldest Eocene or Midway stage. In the Lignitic a vast number of variations have been noticed, but to describe them in detail would require a great number of plates and several hundred pages of text. The subject will here be dismissed with simply the following remarks.

Form α. This is sub-circular in outline with the exception of the beak, and is remarkable for its paucity of ribs. These are about twenty-three in number, and near the umbo are narrower than the interspaces ; in the center of the shell ribs and interspaces are of about equal width ; near the base margins the ribs increase rapidly in width and in some specimens coalesce. Localities for this form are Nanafalia (occasionally) at the base of the Lignitic, and four miles above Hamilton bluff on the Alabama river, near the summit of the Lignitic.

Form β. A large somewhat triangular variety of 28 or 30 costæ, with a tendency to become nasute posteriorly. These features are shown to some extent in pl. 9, fig. 1. It will be observed that on the greater portion of the surface the ribs are far wider than their interspaces. In the center of each rib there is often a trace of an interrupted, raised, radiating line. Hinge, powerful. Typical localities, Gregg's landing, Bell's landing, occasionally at Yellow bluff.

Form γ. A large heart-shaped variety of about 20-22 ribs, distinct near the umbo, but quickly becoming reduced to very faint undulations on a comparatively smooth surface. This form is shown by figs. 1-4, pl. 10. It is fairly abundant at Woods bluff and Ozark, and in the Lower Claiborne at Lisbon. Specimens from 1¼ miles w. s. w. of Choctaw corner, combine the outline of β. with the surface of γ.

Form δ. This is the form found in such great profusion at Hatchetigbee bluff. Of all American specimens this seems most nearly related to the *V. planicosta* of Bracklesham bay and the Calcaire grossier in general. A specimen from Woods bluff showing most of the features of this form is shown on plate 10, fig. 5. The ribs, about 30 in number, are obsolescent on the lower moiety of the shell. There is here a tendency to show a slight straightening or truncation of the anterior sub-margin, a feature so noticeable in specimens from the Calcaire grossier horizon of Europe, and one that generally serves to distinguish at once foreign from American specimens. A small specimen of this variety has been described and figured by Conrad under the name of *Cardita densata*, Jour. Acad. Nat. Sci. Phila., vol. i, pl. 14, fig. 24.

Lignitic localities.—Alabama: Nanafalia; Tuscahoma; Woods Bluff; 1¼ miles w. s. w. of Choctaw Corner; Yellow Bluff; Gregg's and Bell's Landings, four miles above Hamilton Bluff; Ozark. Georgia: Ft. Gaines.

Specimens figured.—Pl. 9, fig. 1, Bell's Landing; Harris collection. Fig. 2 and fig. 3, Woods Bluff, C. U. collection; p. 130, pl. 10, Woods Bluff, Paleont. Museum, Cornell University.

Venericardia alticostata, var. Pl. 11, fig. 1.

Syn. See Bull. Amer. Paleont., vol. i, p. 171, 1896; add:—
Cardita decusata Tuomey, 2d Biennial Rep't, p. 271, 1858.

V. rotunda var. Ald., Bull. 1, Geol. Surv. Ala., p. 57, 1887.

Conrad's original description. — See Bull. Amer. Paleont. as above. The general form of this variety is certainly that of *V. rotunda* Lea, but the costation is different, in fact very similar to *alticostata*, i. e. towards the anterior the exterior crenulated portion of each rib is superimposed on a broader base, which in turn is sometimes on a second base and the latter upon the shell itself. This form is found at Gregg's landing, Lower Peach Tree, and perhaps at Nanafalia.

Smaller, but more nearly typical specimens of this species are found in abundance in the upper Lignitic at Woods bluff and Ozark, Ala.

Specimens figured.—Gregg's Landing; Paleont. Museum, Cornell University.

Astarte smithvillensis, var. Pl. 11, fig. 2.

Syn. *A. conradi* Buckley, 1st Bull. Ann'l Rep't Geol. Surv. Tex., p. 63, 1874.
Crassatella alta (young) Heilp., Cont. to Geol., p. 38, 1884.
Astarte nicklensii Ald., Bull. 1, Geol. Surv. Ala., pp. 50–53, 1886.
Astarte tellinoides Ald., Bull. 1, Geol. Surv. Ala., p. 53, 1886.
Astarte tellinoides Heilp., Proc. Acad. Nat. Sci. Phila., 1890 p. 402.
Astarte smithvillensis var. Har., Proc. Acad. Nat. Sci. Phila., 1886, p. 475, pl. 20, fig. 6.
A. smithvillensis Har., Proc. Acad. Nat. Sci. Phila., 1895, p. 48, pl. 1, figs. 8, a, 9, a, b, c.

Harris' original description.—"Size and general form as indicated by the figures; surface in typical specimens marked by strong concentric rugæ, especially towards the base; these slope gently above but abruptly below and are superimposed by fine striæ; umbones flattened.

"This species shows great variations in form and size as well as markings. At Collier's Ferry some specimens are more elongated, others more rotund; some have crenulations on the anterior sub-margin while others are smooth." Typical locality and horizon, Smithville, Texas. Lower Claiborne.

Localities (Lignitic).—Woods Bluff and Ozark, Ala.

Type.—Texas State Museum.

Specimen figured.—Woods Bluff, Lea Memorial collection in Acad. Nat. Sci., Phila.

Crassatella tumidula, Pl. 11, figs. 3, 4.

Syn. *Crassatella alta* Tuomey, 2d Biennial Rep't, p. 271, 1858.
C. tumidula Whitf., Amer. Jour. Conch., vol. i, p. 267, 1865.
C. tumidula Ald., Bull. 1, Geol. Surv. Ala., p. 57, 1886.

Whitfield's original description.—"Shell sub-triangular or sub-clavate in outline; anterior end broadly rounded; posterior end narrow, acute; valves ventricose in front, attenuated behind, with a shallow sulcus in front of the umbonal slope; surface smooth, except rugose markings on the umbones; hinge teeth moderately large; lateral tooth elongate, linear; ligamental area shallow, broad-triangular; muscular scars large; anterior sub-reniform; posterior circular; margin of shell finely crenulate on the anterior and antero-basal portions.

"Closely resembles *C. petropsis* Gabb, a Cretaceous species.

"*Locality.*—Six miles above Claiborne, Alabama, west side of the river."

The locality designated is doubtless Gregg's landing.

Whitfield's specimen was small but the description is such as to determine the species beyond a doubt.

Localities.—Gregg's Landing; Bell's Landing, and Yellow Bluff, on the Alabama River.

Type.—Hall's collection.

Specimens figured.—Yellow Bluff; Paleont. Museum, Cornell University.

Crassatella halei, n. sp. Pl. 11, fig. 5.

Syn. *Crassatalla mississippiensis* Tuomey, 2d Biennial Rep't p. 271, 1858.
? *Crassatella* sp. Ald., Bull. 1, Geol. Surv. Ala., p. 57, 1886.

Specific characterization.—Size and general form as indicated by the figure; roughly quadrangular and with coarse concentric lirations while young, becoming rapidly smoother with additional increments of growth until near the basal margin in the adult state the surface is again more or less rugose; basal margin very arcuate; posterior truncate; post-umbonal slope broad with often a faint longitudinal medial depression; large tooth in right valve set much more obliquely than in the preceding species; margin may be either crenate or not crenate.

Named in honor of C. S. Hale, who first investigated and described the Lignitic beds of Alabama.

Localities.—Alabama: Nanafalia (a varietal form); Yellow
Bluff; Gregg's Landing. Georgia: Ft. Gaines.

Type.—Gregg's Landing; Paleontological Museum, Cornell University.

Crassatella producta, Con.

This Aldrich cites from Hatchetigbee bluff, Bull. 1, Geol. Surv. Ala., p. 50, 1886, but our collections from that locality do not contain it.

"Kellia" prima, Pl. 11, figs. 6, a.

Syn. *K. prima* Ald., Bull. Amer. Paleont., vol. ii, p. 181, pl. 6, figs. 3,a.

Aldrich's original description.—See p. 181 of this volume.

We are under the impression that this species should be referred to another genus, but having no good specimens at hand it has seemed best to designate it as above for the present.

Localities.—Texas: Sabinetown. Alabama: Choctaw Corner.

Type.—Choctaw Corner; Aldrich's collection.

"Fabella" oblonga, Pl. 11, figs. 7, 8,

We have no specimen of this species. See Bull. Amer. Paleont., vol. ii, p. 182, pl. 6, fig. 2.

Locality.—Choctaw Corner.

Type.—Aldrich's collection.

"Scintilla" clarkeana, Pl. 11, fig. 9.

We have no specimens of this species. See Bull. Amer. Paleont., vol. ii, p. 182, pl. 6, fig. 8.

Locality.—Choctaw Corner.

Type.—Aldrich's collection.

Protocardia lenis var. Pl. 12, fig. 1.

Syn. *Cardium* (*Protocardia*) *lene* Con., Proc. Acad. Nat. Sci. Phila., 1855, p. 258.
Cardium nicoleti Tuomey, 2d Biennial Rep't, p. 271. 1858.
Protocardia virginiana Con., Proc. Acad. Nat. Sci, Phila., 1864, p. 211.
Cardium (*Protocardia*) sp. Heilp., Proc. Acad. Nat. Sci. Phila., 1880, p. 365.
Protocardia nicolleti Ald., Bull. 1, Geol. Surv. Ala., pp. 53, 57, 1886.

Protocardia virginiana? Har., Proc. Acad. Nat. Sci. Phila. 1896, p. 475, pl. 20, figs. 7, 8.

Conrad first refers to the typical form of *lenis* as follows:

" A species of *Cardium* very nearly allied to this [*P. nicolletti*], I formerly believed to be the same; but it accompanies a different group, and presents variations entitling it to be a specific distinction.

" It is from Pamunkey river, Va.

"Compared with *C. nicolletti*; umbo less inflated, posterior margin oblique, shell proportionally longer, and the radiating lines 22; in the other 25. The posterior cardinal tooth larger, &c. It may be named *C. lene*."

In 1864 Conrad evidently forgot that he had already named this species and accordingly described and named it this time as *Protocardia virginiana*. He gives the same locality, Pamunkey river, and remarks that "the species is smaller and proportionally longer than *P. nicolletti* with a smaller umbo. "Also "height 1½ in.; length 1 2-5 in."

The variety from the Lignitic of Alabama is much smaller than the Virginian type. Yet it seems somewhat more nearly related to the latter than to *nicolletti*, but all may prove one and the same. From *nicolletti* it differs not only in its smaller size, but, as stated a year ago, by its smaller umbones, and also by the fact that the area with radiating lines not only occupies the post-umbonal slope, but has 8 or 10 lines on the lateral area of the shell.

Localities.—Alabama: Woods bluff; Gregg's Landing; Bell's Landing; Ozark; four miles above Hamilton Bluff, Alabama River.

Cardium hatchetigbeense, Pl. 12, figs. 2, a.

Syn. *Cardium hatchetigbeense* Ald., Bull. 1, Geol. Surv. Ala., 1886, p. 39. pl. 4, figs. 12, a, b.

Aldrich's original description.—"Shell large, subquadrate, ventricose with about thirty-two ribs; ribs flattened oval, with the scars of spines visible along their center; a few coarse, flattened, triangular spines remaining on the posterior and anterior, largest on the posterior, which is sub-truncate, the largest rib forming the angle; marginal serrature largest at the angle. The flattened spaces between the ribs are equal in width to the ribs and nearly smooth, showing faintly the lines of growth. Cardinal teeth in the left valve double, the lower one the largest, very strong and erect.

"*Locality.*—Hatchetigbee Bluff, Ala."

Type.—Hatchetigbee Bluff, Aldrich's collection.

Specimens figured.—Hatchetigbee Bluff, Aldrich's collection.

Cardium hatchetigbeense? Pl. 12, fig. 3.

This specimen from Sabinetown, at first seemed quite different from *hatchetigbeense*, since it is nearly double the dimensions of the latter, the spaces between the ribs are often sharply striate transversely, and the ribs are regularly pitted where spines have been dislodged. These spines must have been very large on the posterior slope. By carefully examining Aldrich's types their pits can be found in certain places. The size of this shell reminds one at once of *C. harrisi* Vaughan, but by placing the type of the latter by the side of this specimen, many distinguishing characters appear.

Cardium tuomeyi, Pl. 12, fig. 4.

Syn. *Cardium vicksburgense* Tuomey, 2d Biennial Rep't, p. 269, 1858.
Cardium tuomeyi Ald., Bull. 1, Geol. Surv. Ala., Ald., 1886, p. 40, pl. 4, figs. 13, a.

Aldrich's original description.—"Shell ovate, thick through the umbones; ribs numerous, about forty-four in number, flattened above and indented with scars of spines; spaces between the ribs much smaller than the ribs themselves; a few small, scattered spines near the beaks, which are central and raised; muscular scars strongly marked.

"*Locality.*—Nanafalia, Ala.

"Differs from the previous species described by its more numerous ribs, more rounded form, smaller spines and thicker shell."

Casts indicate that this species grew to a fairly large size in the vicinity of Ft. Gaines, Ga.

Type.—Aldrich's collection.

Specimens figured.—Paleont. Museum, Cornell University.

Coralliophaga prima n. sp. Pl, 13, figs. 4, 5.

Specific characteristics.—Size and general form variable, the adult elongate form being shown by the figures; surface with concentric lines about the umbones, becoming rugose and lamellar posteriorly; teeth sometimes becoming obsolete in old specimens but when well preserved showing in the left valve one strong, nearly horizontal cardinal tooth, with a deep pit on either side; right valve with two cardinal teeth as shown in the figure; pallial sinus not deep but well defined; numerous traces of radiating striæ.

The dentition of this species seems to be precisely that of *C. lithophagella* Lam., neither have any lateral teeth worthy of the name. On the other hand the pallial sinus is far too deep for this genus, and approaches that of *Petricola*. The radiating striæ also recall the latter genus. That it was a boring shell, I have no doubt.

Locality. — Alabama: Found abundantly in the indurated, bluish, fossiliferous, thin ledges in Hatchetigbee Bluff. A fragment of a very large specimen, probably of this species, is in Harris' collection from Gregg's Landing.

Type.—Paleontological Museum, Cornell University.

Meretrix nuttalliopsis, Pl. 12, fig. 5.

Syn. *Cytherea nuttalliopsis* Heilp., Proc. Acad. Nat. Sci. Phila., 1880, p. 370, pl. 20, fig. 1.
C. nuttalliopsis Ald., Bull. 1, Geol. Surv. Ala., pp. 53-57.
? C. mimina Ald., Bull. 1, Geol. Surv. Ala., pp. 53-57.

Heilprin's original description.—"Shell sub-elliptical, moderately ventricose, its surface covered with fine concentric striæ, which are apt to become roughly imbricate on the basal margin; umbones not very prominent, rather anterior; lunule cordate, deeply impressed at about its middle, its outline clearly pronounced by a sharply impressed line; posterior extremity regularly rounded, the anterior somewhat produced; margin entire; pallial sinus somewhat angular, pointing towards the center of the shell.

"Length, 1½ inch. Knight's Branch, Charke Co., Ala.

"This species most resembles among American species of *Cytherea* the *C. nuttalli* Con., from which it may be distinguished by the greater production forward of the anterior extremity, and by the median depression in the lunule. In this last character it agrees with *C. poulsoni* Con., from which, however, it very materially differs in form, and in the much less development of the umbones."

The nomenclature of the lower Eocene *Meretrices* is still in an extremely unsettled state. Specimens of this species from Woods bluff are extremely abundant, well preserved and typical in form. Those from the mouth of Bashi creek and Ozark are still quite typical though somewhat smaller than at Woods bluff and sometimes tending to be a little more triangular in outline. The same remark applies to those from four miles above Hamilton bluff on the Alabama.

Variety **greggi** n. var. Pl. 13, figs. 1, 2.

Syn. *Meretrix nuttalliopsis* Har., Proc. Acad. Nat. Sci. Phila., 1896, pl. 22, figs. 1, 2. Erroneously written *M. mortoniopsis* l. c., p. 477.

Descending in the geologic scale to Bell's and Gregg's landings and Lower Peach Tree, somewhat wider variations are met with. The forms more rotund posteriorly, probably females (pl. 13, fig. 1) have a close resemblance to *nuttalliopsis*, while the specimens more pointed posteriorly, probably males, (pl. 13, fig. 2) would not at first sight be placed under this species.

Variety **fulva** n. var. Pl. 12, figs. 8–10.

At Yellow bluff on the Alabama, and at Ft. Gaines, Ga., a variety occurs still farther separated from the typical form. Here also two mutations are observable, probably owing to sex, one rounded posteriorly, the other more or less pointed. Fig. 10 shows the blunt form, young, fig. 9 the pointed form, young, fig. 8 an adult. This form is unusually developed anteriorly, and has a tendency to become inflated or bulged up along the umbonal ridge. The reason for not giving a new specific name to this marked variety is, that some of its phases are indistinguishable from certain forms of *greggi*, and the latter is certainly but a variety of *nuttalliopsis*. The intimate relationship, or perhaps specific identity of this species with *Meretrix riplyana* Gabb, will doubtless be satisfactorily proven. Likewise its identity with *M. ovata* Rogers, and other Virginian forms will probably be shown.

Type specimens figured. — Paleontological Museum, Cornell University.

Meretrix subimpressa var. Pl. 12, figs. 6, 7.

Syn. *C. subimpressa* Con., Jour. Acad. Nat. Sci. Phila., vol. i, p. 130, pl. 14, fig. 26.
C. perovata? Ald., Bull. 1, Geol. Surv. Ala., p. 53.

Conrad's original description. — "Ovate, slightly ventricose, smooth and polished, with concentric slightly impressed lines on the anterior side; anterior side short, rather acutely rounded; posterior side produced, acutely rounded at the extremity; dorsal margin long, oblique, slightly curved; beaks prominent; lunule lanceolate, defined by a slightly depressed line. Length, 1⅛ in. Height, .8 in. Locality: Marlbourne, Hanover county, Virginia. Mr. Ruffin.

"This species may be distinguished from *C. æquorea* by its greater comparative length, smaller size and wanting the strong furrows of that species. Mr. Ruffin obtained several entire specimens."

The variety here referred to has some resemblance to *M. pearlensis* Har., but has no indications of such markings. From *subimpressa* typical it differs in having its upper and basal margins more rectilnear, its posterior very prolonged, but finally abruptly truncated, its anterior more produced and circular, its beaks slightly more prominent. The moderately deep truncated pallial sinus is the same in both.

Many specimens are scarcely distinguishable from young *M. lævigata* Lam.,though the beaks are always a little pronounced and there are no signs of radiating lines.

Locality.—Alabama: Woods Bluff.

Specimens figured.—Paleontological Museum, Cornell University.

Meretrix hatchetigbeensis. Pl. 12, figs. 11, 12.

Syn. *Cytherea hatchetigbeensis* Ald., Bull. 1, Geol. Surv. Ala., 1886, p. 39, pl. 4, fig. 1.

Aldrich's original description.—"Shell rather thick, inflated, sub-rotund, transversely striate—the different periods of growth marked by a dropping down of the concentric lamina, giving a ridge-like appearance; umbones swollen; beaks elevated; lateral tooth in left valve transverse, conical and strong; ligament short-curved; excavation of the pallial impression angular; margin of the shell entire, thickened in some specimens.

Locality.—Hatchetigbee Bluff, Ala., beneath the Buhrstone.

"Prof. A. Heilprin considers this shell a *C. discoidalis* Con., but that is described as having the inner margin crenulate, while this is smooth."

I think this can scarcely be placed under *M. discoidalis* Con. Repub. Conrad's Foss. Sh., Tert. Form, pl. 20, fig. 2. It is very common at Hatchetigbee but has not been noted elsewhere.

? Type.—Aldrich's collection.

Specimen figured. — Hatchetigbee Bluff, Paleont. Museum, Cornell University.

Dosiniopsis lenticularis, Pl. 12, fig. 13.

Syn. *Cytherea lenticularis* Rogers, Trans. Amer. Philos. Soc., vol. vi, p. 372, pl. 28, fig. 1, 1839.
Cytherea eversa Tuomey, 2d Biennial Rep't p. 271, 1858.
Dosiniopsis lenticularis Ald., Bull. 1, Geol. Surv. Ala., p. 57, 1886.
Dosiniopsis lenticularis Har., Amer. Jour. Sci. vol. 47, p. 302, 1894.

Rogers' original description.—"Shell large, depressed, discoidal rather thick, length nearly equal to the breadth; transversely striated; lunule long, ovate, obscurely defined by a very faint impressed line; umbones rather depressed; beaks small, hardly recurved; teeth straight, divergent; cavity of the shell not deep; margin entire. Diameter about two inches.

"Locality, eastern Virginia, in the Eocene, where it is a common species.

"*Remarks.*—From the extreme friability of this shell it has been impossible hitherto to procure a perfect specimen. It differs from all the *Cythereæ* of our American Eocene beds in its nearly orbicular form, and its slight degree of inflation. The insulated tooth of the right valve is long, straight, and not much elevated. The anterior cardinal tooth in the same valve is slightly bifid. The striæ upon the surface of the disc are almost obsolete, where decay has not removed the external laminæ. The small incurvation in the beaks distinguishes it from *C. poulsoni* of Conrad (*C. globosa* La.), to which species it bears some resemblance."

Localities (Gulf slope).—Alabama: Bell's Landing. Georgia: Ft. Gaines.

Type.—

Specimen figured.—Bell's Landing; Harris' collection.

Corbicula cornelliana n. sp. Pl. 13, fig. 3.

We have only a fragment of this interesting form, and, were it not of universal interest we would pass it by unnoticed, unnamed. But the discovery of this genus or one very closely allied to it, as indicated by the long, curved anterior lateral tooth and three cardinals, a brackish water type, in the upper Lignitic, seems worthy of special remark. External striation about the umbo indicates that the shell when entire is more or less triangular in outline with angles very obtusely rounded, and sides curving, especially the base. It is quite gibbous. The right valve here figured show the long groove or socket for the anterior lateral of the left valve. A cavity below and behind the umbo is formed, as in *Dosinia*, by the decaying of soft shelly matter.

Locality.—Alabama: Hatchetigbee Bluff.

Specimen figured. — Paleontological Museum, Cornell University.

Psammobia ozarkana n. sp. Pl. 12, fig. 14; pl. 13, fig. 8.

Specific charactization.—General form of the shell as figured; when young, anterior slightly longer than posterior, narrowing rapidly towards anterio-basal margin, posterior broadening, slightly truncated on the posterior-dorsal margin; surface irregularly striate concentrically, slightly depressed from beak to base, with two or three obscure radiating folds extending from beak to basal margin just anterior to the posterior-basal margin.

Resembles *P. eborea* Con. somewhat, but has not the extended posterior of that species, the general form of the shell is not so elongate and the anterior cardinal tooth is not so large and well developed.

Locality.—Alabama: Ozark.

Type.—Paleontological Museum, Cornell University.

Sphærella sp. Pl. 13, fig. 6.

This specimen is very probably a varietal form of our *S. anteproducta* from Texas (Proc. Acad. Nat. Sci., Phila., 1895, p. 50, pl. 2, fig. 4), but since it is the only specimen in our collection from Hatchetigbee bluff, it seems best to postpone its identification until more material is obtained.

Diplodonta sp. Pl. 13, fig. 7.

This, and many fragments of larger specimens were found at Woods bluff. We await a more thorough investigation of the Maryland and Virginia Eocene before identifying the form specifically.

Solen sp. Pl. 13, fig. 9.

This, and other fragments of this genus were found at Ozark, Ala., none of which however, were well enough preserved for specific identification.

Mactra prætenuis var. **bistriata,** Pl. 13, fig. 10.

Syn. *M. prætenuis* Con., Foss. Sh., Tert. Form, p. 42, 1833. Harris' reprint, pl. 19, fig. 9.
M. prætenuis Con., Amer. Jour. Sci., vol. i, p. 217, pl. 2, fig. 4.
M. prætenuis Ald., Bull. 1. Geol. Surv. Ala., p. 50. 1886.

Conrad's description of prætenuis.—"Shell sub-triangular compressed, equilateral, thin and fragile; umbonal slope sub-marginal, nearly rectilinear, carinated; beaks slightly prominent; lunule narrow elliptical; two slightly prominent lines behind the umbonal slope." Locality, Claiborne sand.

There is some reason for supposing this to be a distinct species from *prætenuis*. It is smaller, and has both anterior and posterior umbonal slopes well and deeply marked by concentric lines, especially near the margins. This is especially true of the Sabinetown specimens.

Localities.—Alabama: 4 miles above Hamilton Bluff, on the Alabama; Ozark. Texas: Sabinetown Bluff, Sabine River.

Type of prætenuis.—Acad. Nat. Sci., Phila.

Specimen figured.—Ozark, Ala. Paleont. Museum, Cornell University.

Corbula concha, Pl. 13, fig. 11.

Syn. *C. concha* Ald., Bull. Amer. Paleont. vol. i, p. 71, pl. 6, fig. 6, 1895.

Aldrich's original description.—"Shell oblong, ovate, inequilateral; surface striate; posterior somewhat produced and rounded, and the larger; anterior elliptically rounded; tooth large and oblong; cicatrices very slightly impressed; cavity of shell rather deep.

"*Locality.*—Bell's Landing, Ala.

"*Geological horizon.*—Bell's Landing, section of the Lignitic.

"A large species of this genus. It differs from any other by its smooth surface, large posterior end, and faint muscular impressions."

Our specimen is from near the mouth of Bashi creek, in the Woods bluff horizon.

Type.—Aldrich's collection.

Specimen figured.—Near the mouth of Bashi creek; Paleontological Museum, Cornell University.

Corbula aldrichi, Pl. 13, figs. 12, 13, a.

Syn. *Corbula rugosa* Heilp,, Proc. Acad. Nat. Sci., Philà., 1880, p. 364.
Corbula oniscus Heilp., Proc. Acad. Nat. Sci., Phila., 1880, p. 364.
Corbula gibbosa Heilp., Proc. Acad, Nat. Sci., Phila., 1880, p. 364.
Corbula aldrichi Meyer, Amer. Jour. Sci., vol. 30, p. 67, 1885.
Corbula aldrichi Ald., Bull. 1, Geol. Surv. Ala., p. 83, pl. 1, fig. 21, 1886.
Corbula rugosa Heilp., non Lam., Proc. Acad. Nat. Sci., Phila., 1890, p. 401.

Meyer's original description.—"Rounded trigonal; ventricose; posterior side carinated; beak small, curved anteriorly, in the left valve nearly in the middle; right valve briefly rostrated; in both valves the umbonal part is without concentric ribs, but with impressed, radiating lines—the ventral part with concentric ribs.

"*Locality.*—Woods Bluff, Ala.

"The radiating lines cut only the first ribs and and disappear completely at the ventral part. The species is similar to *Corbula gibbosa* Lea, but distinguished mainly by the smooth umbonal part and the radiating lines."

Heilprin has in several instances referred this species, as well as Conrad's *oniscus* and Lea's *gibbosa* to *C. rugosa* Lam. Were ones observations confined to the larger valve (right) this commingling of different species might be excusable. *C. aldrichi* does not always have radiating lines on the umbones nor are these parts always void of concentric striation. The radiate structure is made visible doubtless by slight erosion. Some specimens from Ozark, and 4 miles above Hamilton bluff, on the Alabama, and from Hatchetigbee, have the nasute posterior, the very strong liræ and in general, appear like small *oniscus*. But with them are specimens varying to the *aldrichi* type, and all left valves found are of the short, rotund shape of the latter species, and seem to have no relationship to the inferior, operculate, radially folded and grooved left valve of *oniscus*.

A very minute specimen from Gregg's landing, about as large as a pin head shows, when highly magnified, a smooth, rotund left valve, and a similar but larger right valve, strongly striate concentrically, to the very beak. No radii are present.

Type.—Aldrich's collection.

Localities (Lignitic).—Alabama: Woods Bluff; near mouth of Bashi creek; Gregg's Landing; 4 miles above Hamilton Bluff; Hatchetigbee; Ozark.

Specimens figured.—Hatchetigbee; Paleont. Museum, Cornell University.

Corbula alabamiensis var. Pl. 13, fig. 14, a.

Syn. *C. engonata* Ald.. Bull. 1, Geol, Surv. Ala., p. 58, 1886.

This variety is by no means so large nor so inflated as *alabamiensis*, yet some specimens seem to indicate a transitional stage so far as form is concerned. ·From *Corbula engonata* this is distinguished by its more compressed form, smaller concentric lines and more rectilinear base.

Locality.—Alabama: Gregg's Landing.

Specimen figured.—Paleont. Museum, Cornell University.

Corbula alabamiensis.

Syn. *C. nasuta* Con. (preoccupied) Foss. Sh., Tert. Form, p. 38, 1833; pl. 19, fig. 4 of Harris' republication.
C. alabamiensis Lea, Cont. to Geol., p. 45, pl. 1, fig. 12, 1833.
Corbula nasuta Ald., Bull. 1, Geol. Surv. Ala., p. 58, 1886.

Lea's original description.—"Shell inflated, triangular-ovate, angular behind, transversely and finely stiate, inequilateral, very inequivalve, anterior part the larger; beaks incurved and rather pointed; tooth of the right valve large, pointed and fitting under the beak of the left valve; posterior basal margin straight or slightly emarginate; the two great cicatrices distinctly impressed; cavity of the valves deep. Diameter 7-20ths. Length .4. Breadth .7 of inch." Claiborne, Ala.

The specimens here included under typical *alabamiensis*, are much smaller than most specimens from Claiborne. There seems, however, to be little doubt of their identity.

Localities.—Alabama: Yellow Bluff; 4 miles above Hamilton Bluff; Hatchetigbee Bluff.

Type.—Academy Natural Sciences, Philadelphia.

Pholas alatoidea, Pl. 13. fig. 15.

Syn. *Pholas roperiana* Tuomey, 2d Biennial Rep't, 272, 1858.
Pholas alatoidea Ald., Bull. 1, Geol. Surv. Ala., p. 36, pl. 4, figs. 9, b, c, 1886.

Aldrich's original description.—"Shell elongate, cylindrical, posterior end concentrically striated, anterior half of the shell crossed with raised radial lines forming imbrications, which grow stronger as we approach this end. Anterior dorsal margin winged, this part showing only the continued concentric lines; umbonal processes large, reflected; anterior ventral margin strongly notched. Internal process broad, spatulate.

"*Localities.*—Gregg's Landing and Bell's Landing, Ala."

Type.—Aldrich's collection.

Specimen figured.—Gregg's Landing; Paleont. Museum, Cornell University.

Glycymeris alabama, n. sp. Pl. 13 fig. 16.

Syn. *Panopæa* sp. Ald., Bull. 1, Geol. Surv. Ala., p. 58, 1886.
Panopæa porrectoides var? Har., Proc. Acad. Nat. Sci., Phila., 1896, p. 478, pl. 22, fig. 4.

Specific characterization.—General form of a well preserved specimen as indicated by the figure; less developed anteriorly than *porrectoides*; a slight or strong median constriction from umbo to base, causing oftentimes an indentation in the basal margin; of a far more slender form, smaller size, and less symmetrical laterally than *elongata* Con.

Localities.—Alabama: Gregg's Landing. Georgia: Ft. Gaines, near base of Lignitic.

Type.—Lea Memorial Collection in Acad. Nat. Sci., Phila.

Specimen figured.—Lea Memorial Collection in Acad. Nat. Sci., Phila.

Martesia elongata, Pl. 14, fig. 1.

Syn. *M. elongata* Ald., Bull. 1, Geol. Surv. Ala., p. 37, pl. 4, fig. 10, 1886.

Aldrich's original description.—"Shell gaping above, elongated, sub-cylindrical; the anterior and central part of surface marked with concentric ribs, balance of posterior smooth. A strongly impressed groove running from the beak to the ventral margin, the concentric ribs being more pronounced on the sides of this groove.

"Beaks strongly recurved towards the anterior, situated close to this end, which is truncate.

"*Locality.*—Yellow Bluff, Ala., Bell's Landing Group."

"This species was taken from a piece of lignite by D. W. Langdon Jr. The shell has the markings of the dorsal accessory plate."

Type.—Herewith refigured, Aldrich's collection.

Lucina greggi. Pl. 14, figs. 2, 2a?

Syn. *L. greggi* Har., Proc. Acad. Nat. Sci., Phila., 1896, p. 478, pl. 22, fig. 6.

Harris' original description.—Size and general form as indicated by the figure; marked exteriorly with concentric lines not deeply incised; interior with two diverging cardinal teeth and an anterior lateral; anterior muscular scar very large and extending from the anterior lateral tooth to the basal margin of the shell; posterior muscular scar comparatively small, rotund; interior naturally (or by disease) much thickened or calloused, a shallow channel extending from a little above the upper margin of the posterior muscular scar, obliquely to near the base of the anterior scar.

"A small specimen, magnified in fig. 5, [2a.] and probably of this species, shows an extremely, deeply excavated ligament pit, reminding one of *L. claytonia.* In the old type specimen, this pit broadens out and the ligament seems to be attached very much as in *Dosinia.*

"*Locality.*—Alabama: Gregg's Landing.

Type.—Lea Memorial Collection, in Acad. Nat. Sci., Phila.

Lucinia pomilia. Pl. 14, fig. 3, a. b.

Syn. *L. pomilia* Con., Foss. Sh., Tert. Form, p. 40, 1833.
L. impressa Lea, Cont. to Geol., p. 37, pl. 1, fig. 30, 1833.
L. pomilia Con., Amer. Jour. Sci., vol. i, p. 402, pl. 4, fig. 17, 1846.
L. pomilia Ald., Bull. 1, Geol. Surv. Ala., p. 57, 1886.

Conrad's original description. — "Shell suborbicular, equilateral, obscurely cancellated, with three or four profound concentric sulci; and an indented fold on both sides, terminating in an emargination of the ends; beaks prominent, lunule profoundly impressed, cordate; cardinal and lateral teeth very distinct; margin crenulated." From Claiborne, Ala.

The specimens in question (Lignitic) are much smaller than their Claiborne representatives and do not closely resemble the adults at the latter locality. Yet the young are the same from both horizons, and there is little doubt but that they are one and the same species.

Localities (Lignitic).—Alabama: Woods Bluff; Ozark; 4 miles above Hamilton Bluff.

Type.—Nat. Acad. Sci., Phila.

Specimens figured.—Woods Bluff; Paleont. Museum, Cornell University.

Lucina symmetrica? Pl. 14, fig. 4.

Syn. *L. rotunda* Ald., Bull. 1, Geol. Surv. Ala., p. 50, 1886.

This *Lucina* from Hatchetigbee, is somewhat closely related to *symmetrica* Con., *rotunda* Lea, but should presumably be described as new. We await more material from this and other upper Lignitic and lower Claiborne horizons.

Lucina ulrichi, Pl. 14, figs. 5, a. 6.

Syn. *L. ulrichi* Clark, Johns Hop. Univ. Circ., vol. xv, p. 5.
L. ulrichi Clark, Bull. U. S. Geol. Surv., No. 141, p. 79, pl. 21, figs. 1, a-d.

Clark's original description.—"Shell small, orbicular; surface with numerous, uniform, elevated, concentric ridges; anterior and posterior sides rounded; interior with radiating striæ; margin simple. Dimensions: Length, 5 mm.; height, 4 mm.

"*Locality.*—Virginia: Woodstock.

The specimens we refer to this species are closely allied to *L. modesta* Con., from Claiborne. But in specimens from that locality the superior portion of the posterior margin extends beyond the inferior, while in this the reverse is true. Again, in the Claiborne specimens the anterior cardinal tooth in the left valve, is frequently well defined and vertical or sloping anteriorly downwards, while in this that tooth is not so clearly defined, and all other teeth are much more obliquely pitched. Again, *pomilia* has a finely crenulated margin. Clark's figures fail to show the internal striæ, and the muscular scars are certainly improperly drawn for the genus *Lucina*. The external ridges in our specimens are mere raised lines. The hinge characters are so represented that there is some doubt as to whether our specimens are really *ulrichi*.

Localities.—Woods Bluff; 4 miles above Hamilton Bluff, Alabama River.

Type.—Johns Hopkins University.

Specimens figured.—Woods Bluff; Paleont. Museum, Cornell University.

Lucina ozarkana n. sp. Pl. 14, figs. 7, a, b.

Specific characterization.—Size and general form as indicated by the figures; exterior nearly smooth, but slightly marked concentrically with fine striæ and by a few more deeply impressed lines of growth or slight unconformability in growth; radiating striation fine but visible; post-umbonal area defined by a slightly depressed radiating line; sub-lunule area, as well as post-umbonal area, with stronger, raised, imbricated lines; interior with cicatrices as shown in the figure; radiating lines prominent but fine; umbonal teeth as indicated by the figures; lateral teeth wanting, or with a faint trace anteriorly in the right valve.

Locality.—Alabama: Ozark, in R. R. cut.

Type figured.—Paleont. Museum, Cornell University.

Lucina astartiformis, Pl. 14, fig. 8.

We have no specimens of this species in our collections. See Bull. Amer. Paleont., vol. ii, p. 181.

Locality.—Alabama: Choctaw Corner.

Type.—Aldrich's collection.

Tellina greggi, Pl. 14, fig. 9, a–c.

Syn. *T. lignitica* Har., Proc. Acad. Nat. Sci., Phila., 1896, p. 477.
T. greggi Har., *ibid* pl. 22, fig. 3, a.
? *T. virginiana* Clark, Bull. 141, U. S. Geol. Surv., p. 76, pl. 15, fig. 4.

Harris' original description.—"Size and general form as indicated by the figures ; substance of shell very thin ; smooth ; two cardinal teeth in each valve ; a furrow in the upper anterior margin of the left valve causes the same to form two obscure teeth.

"*Locality.*—Alabama: Gregg's Landing."

In some unaccountable manner an old manuscript name, "*lignitica*," used in the first draft of the article referred to above, was not changed to the final name *greggi* before going to press. The figures herewith given will show some additional specific characters.

Localities .—Alabama: Yellow Bluff; Gregg's Landing.

Type.—Lea Memorial Collection in Acad. Nat. Sci., Phila.

Tellina (Arcopagia) trumani, n. sp. Pl. 12, fig. 15; pl. 14, fig. 10.

Specific characterization.—Size and general form as indicated by the figures ; teeth in the left valve as shown in fig. 10, in the right as in fig. 10a ; the anterior lateral of the right valve carries above it a deep groove for the like margin of the opposite valve.

Locality.—Gregg's Landing.

Type.—Paleontological Museum, Cornell University.

Tellina subtriangularis, Pl. 14, fig. 11, a-c.

Syn. *T. subtriangularis* Ald., Bull. Amer. Paleont., vol. i, p. 70. pl. 6, fig. 8.
? *T. williamsi* Clark, Bull. 141, U. S. Geol. Surv., p. 79, pl. 15. 3a, 3b, 1897.

Aldrich's original description.—(Loc. cit.)

Localities.—Alabama: Hatchetigbee Bluff; Woods Bluff; Ozark; 4 miles above Hamilton Bluff, Alabama River.

Type.—Aldrich's collection.

Specimen figured.—Woods Bluff, Paleont. Museum, Cornell University.

Solemya alabamensis, n. sp. Pl. 14, fig. 12.

Specific characterization.---Size and general form as indicated by the figure ; sub-cylindrical ; with four fine, rather prominent, radiating, curved ribs on the posterior, and finer lines on the remainder of the shell.

Locality.---Alabama: Alabama River, 4 miles above Hamilton Bluff.

Type.---Paleontological Collection, Cornell University.

Periploma butleriana, Pl. 14, fig. 13, a.

Syn. *P. butleriana* Ald., Bull. Amer. Paleont., vol. i, p. 71, pl. 6, fig. 3.

No specimens of this species are in our collection.

Localities.—Alabama: Butler; Baker's Bluff.

Type.—Aldrich's Collection.

Cuspidaria prima, Pl. 14, fig. 14.

Syn. *Neæra prima* Ald., Bull. 1. Geol. Surv. Ala., p. 38, pl. 6, fig. 14, 1886.

Aldrich's original description.—"Shell rotund, covered with rounded, close-set concentric striæ ; posterior with four radiating ribs ; anterior part smooth. Rostrum moderate, narrow, rounded, with a concave, almost triangular space between it and the body of the shell, the end curving upward ; ventral margin hollowed out ; dorsal margin rising slightly above the hinge line. Cartilage pit, minute, bent inward in left valve, which also has the posterior muscular impression strongly defined by a rib on the inner side running to the dorsal margin ; hinge line nearly straight

"*Locality.*—Alabama: Woods Bluff. (Lower bed).

Type.—Aldrich's collection.

* * ⁂ * *

(Plate 1).

Plate 7.

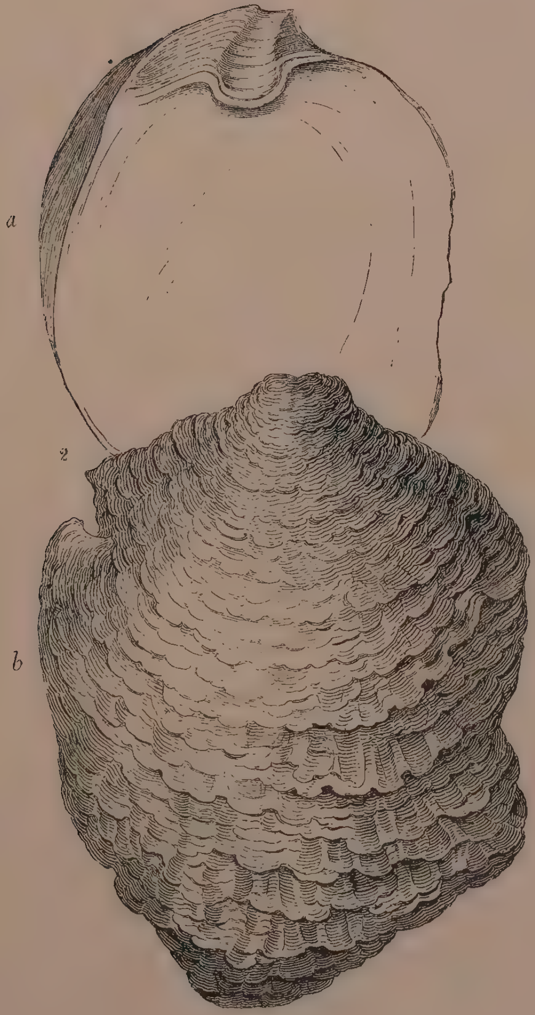
EXPLANATION OF PLATE I.

(**7**)

Page.

Ostrea compressirostra Say.. 37, **229**

These figures were drawn by Lesueur to accompany Say's article in the Jonrnal of the Phila. Acad. Nat. Sci., vol. iv, 1824. See Bull. Amer. Paleont., vol. i, pl. 27.


a
2
b

(Plate 2).

Plate 8.

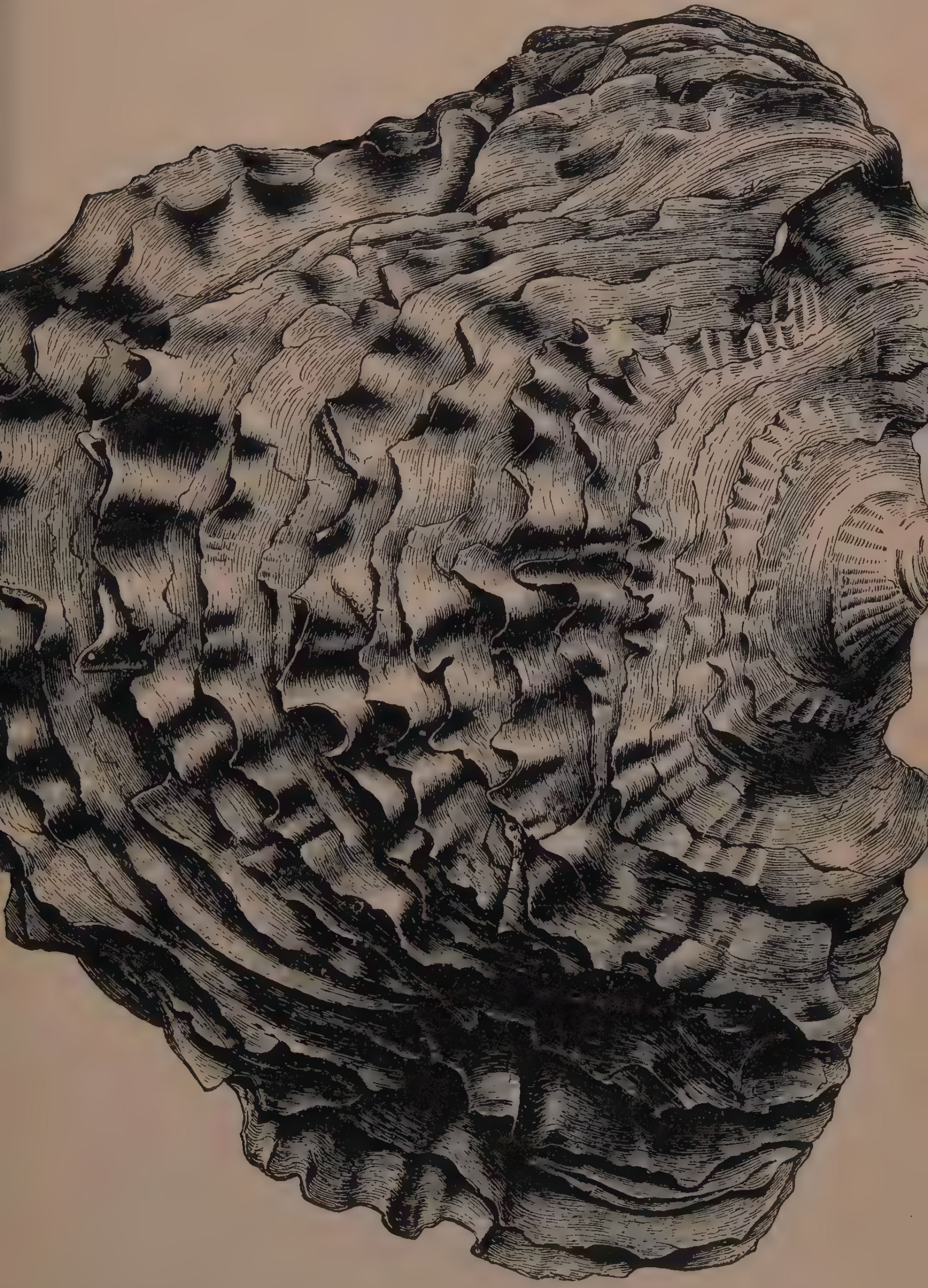
EXPLANATION OF PLATE 2.

(**8**)

Page.

Ostrea compressirostra Say.. 37. **229**

Exterior of a large and perfect left valve as figured in U. S. Geol. Surv. Rep't, 1883, pl. 65. Electrotyped for the present work by Joyce Eng. Co., Washington, D. C.



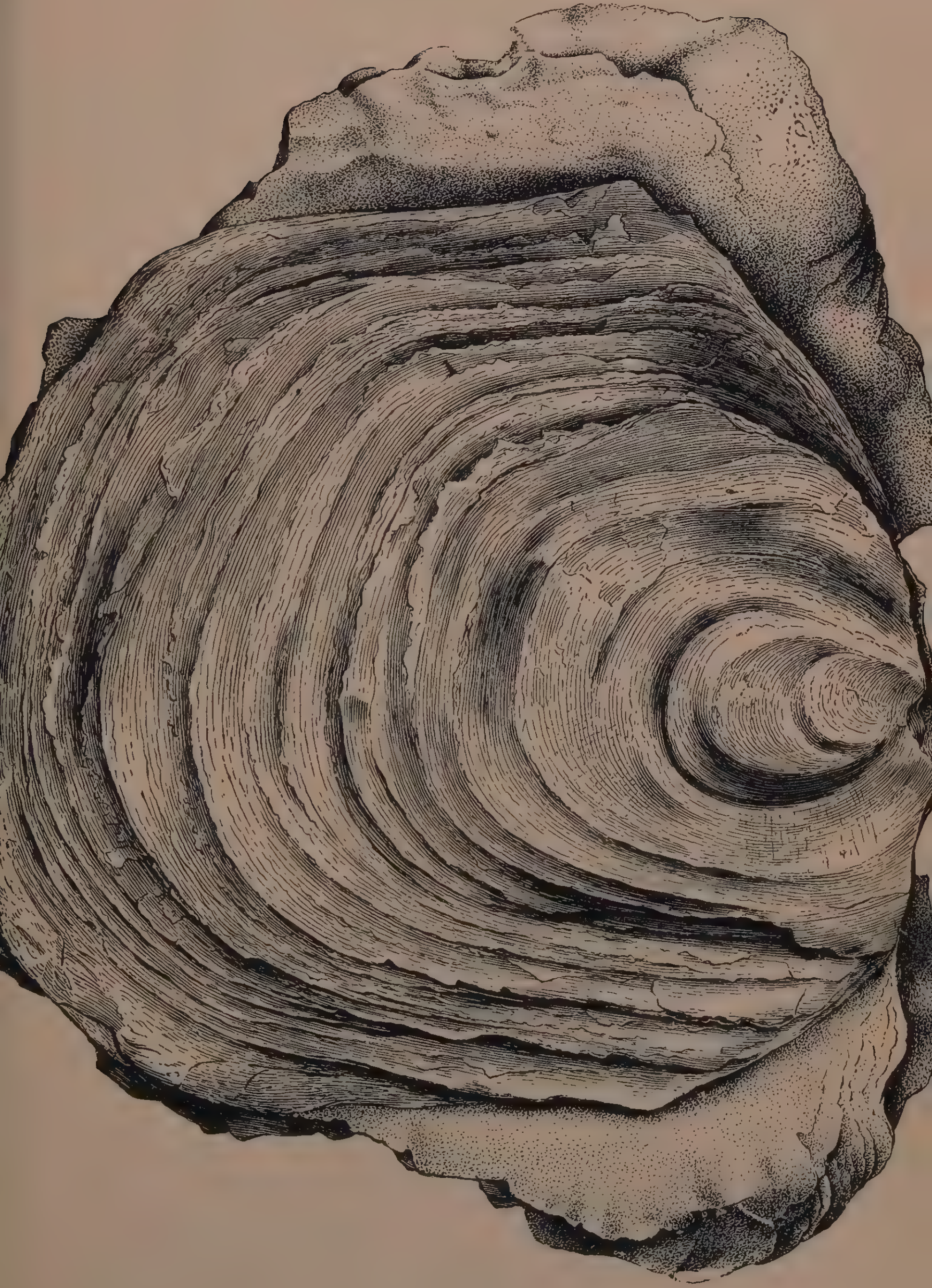
(Plate 3).

Plate 9.

EXPLANATION OF PLATE 3.

(9)

	Page.
Ostrea compressirostra Say...................................... Interior of right valve. See remarks under plate 2.	37, **229**



(Plate 4).

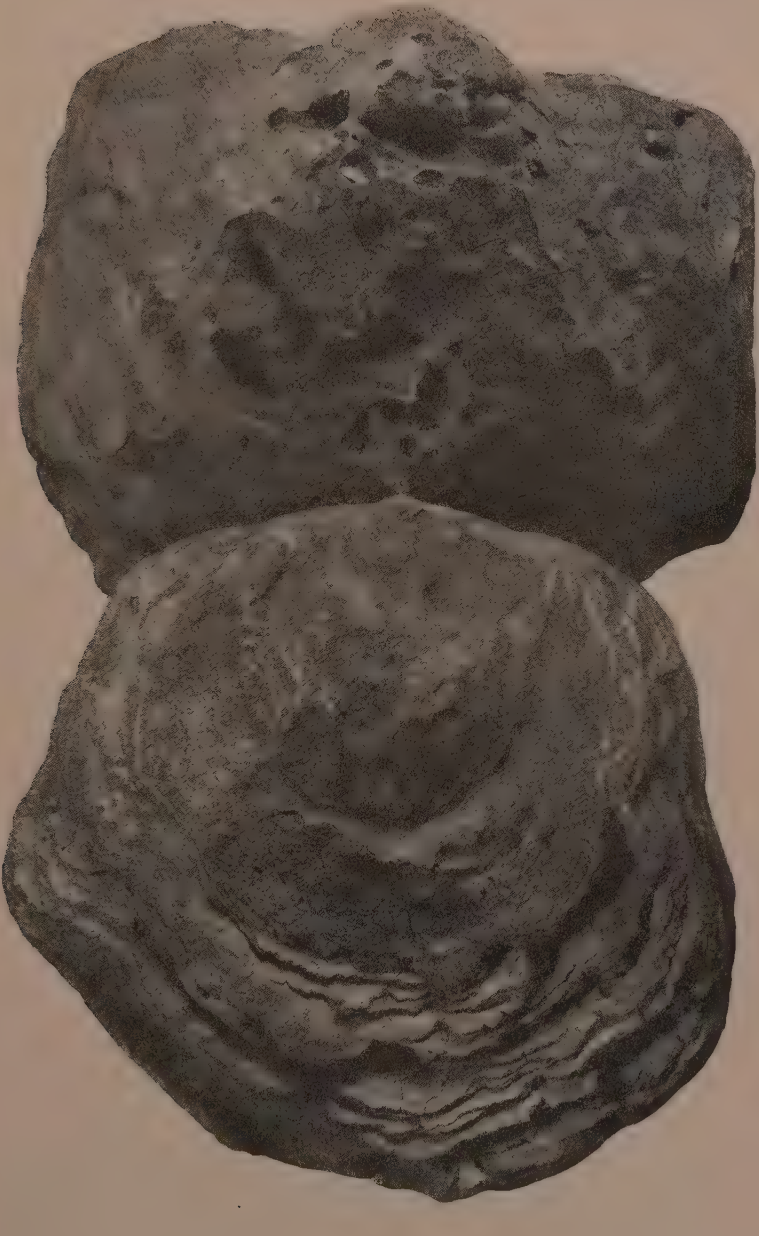
Plate 10.

EXPLANATION PLATE 4.

(10)

	Page.
Ostrea trigonalis var. *sylværupis*................................	38, **230**

Showing exterior of large incrassated valves of this species as obtained from bed 8 at Woods bluff, Tombigbee river. See page 38. The work of boring mollusca is very apparent in the large left valve. Engraved by the Albany Eng. Co.



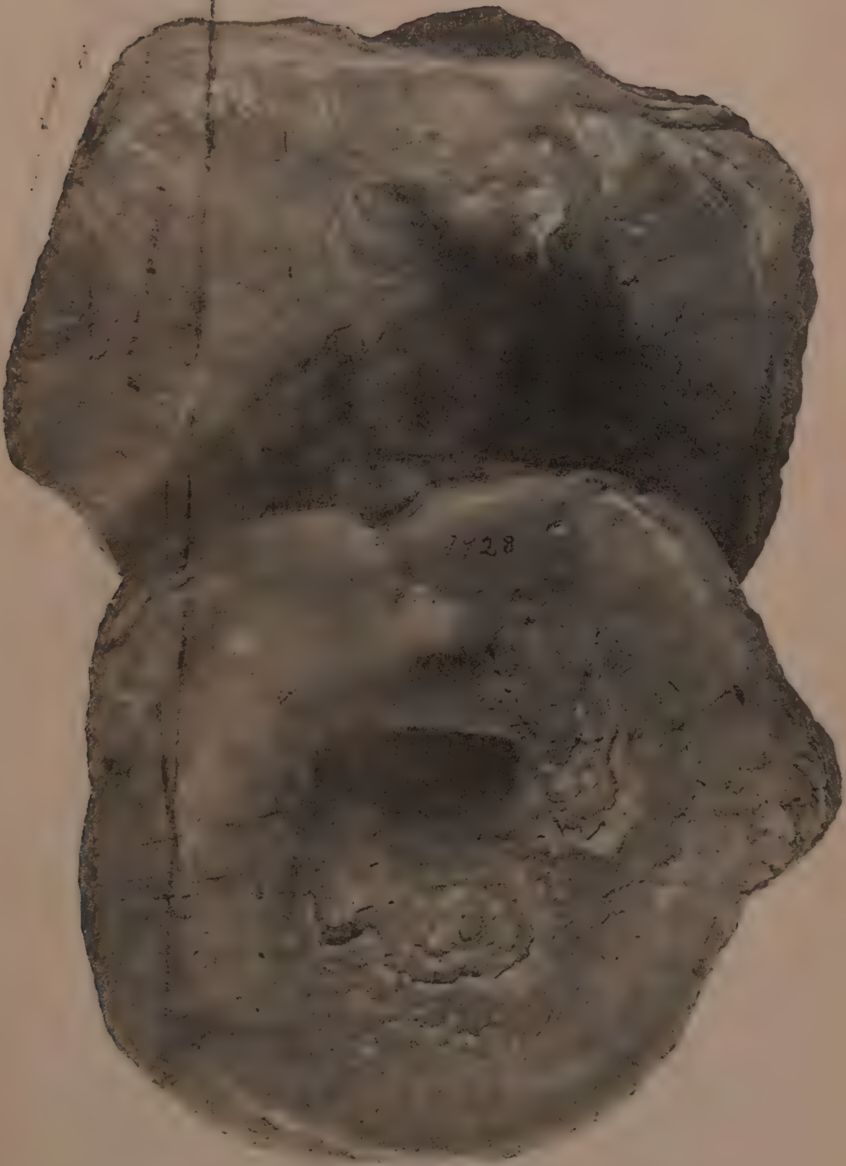
(Plate 5).

Plate 11.

EXPLANATION OF PLATE 5.

(11)

	Page.
Ostrea trigonalis var. *sylværupis* Interior view. See remarks under pl. 4.	38, **230**


1728

(Plate 6).

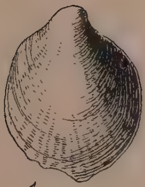
Plate 12.

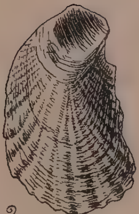
EXPLANATION OF PLATE 6.

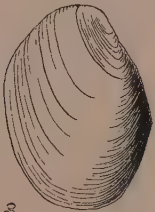
(12)

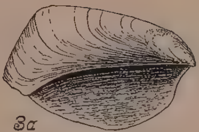
			Page.	
Fig.	1.	*Ostrea compressirostra* Say, (young)	37,	**229**
	2.	*Ostrea sellæformis* Con ?	41,	**233**
	3.	*Ostrea* var. *sylværupis* Har. (young). Exterior of larger valve	38,	**230**
	3a.	The same, lateral view.		
	4.	*O.* var. *sylværupis* Har. (young). Showing valves in normal position	“	“
	5.	*Ostrea thirsæ* Gabb. Showing exterior of larger valve	40,	**232**
	5a.	Interior of the same.		
	6.	*O. thirsæ* Gabb. Showing interior of lesser valve	“	“
	7.	*O. alabamiensis* Lea. Showing radiate epidermal structure	41,	**233**
	8.	*Plicatula filamentosa* Con. (var.)	“	“
	9.	*P. filamentosa* Con., a larger specimen	“	“
	10.	*Anomia* sp	42,	**234**
	11.	*Spondylus*	“	“
	12.	*Lima ozarkana* n. sp	43,	**235**

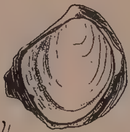
Engraved by the Electro Light Engraving Company, New York.

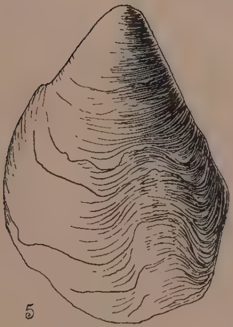

1

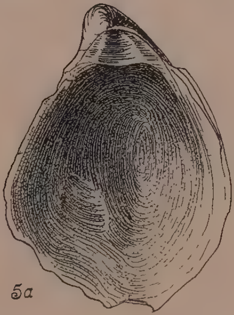

2

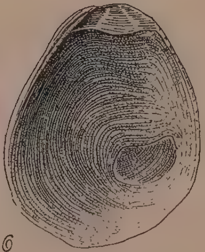

3

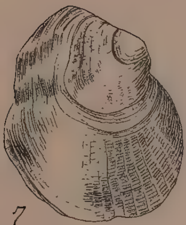

3a

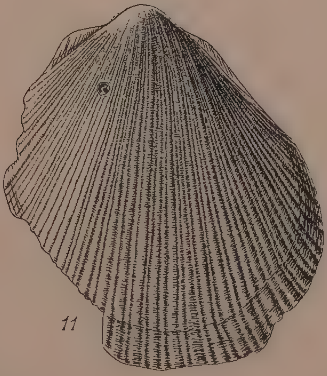

4

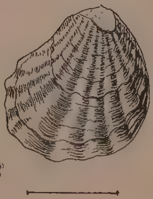

5

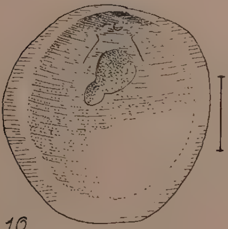

5a

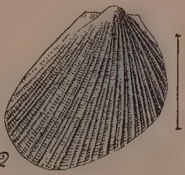

6

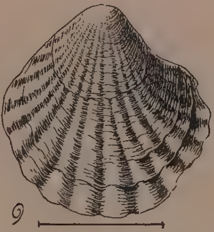

7


11


8


10


12


9

(Plate 7).

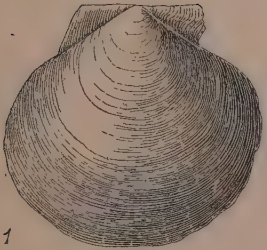
Plate 13.

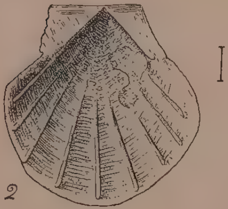
EXPLANATION OF PLATE 7.

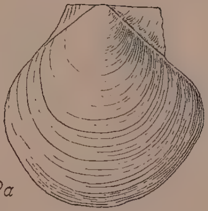
(13)

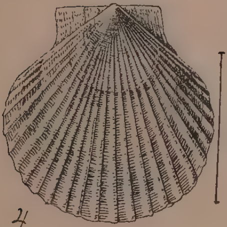
Fig.		Page.
1.	*Pseudamussium claibornense* Con.	43, **235**
2.	*Amussium squamulum* Lam.	44, **236**
2a.	The same, exterior.	
3.	Another specimen showing fine radiate lines.	
4.	*Chlamys greggi* n. sp. Left valve.	45, **237**
5.	Right valve of the same.	
6.	*Chlamys choctavensis* Ald.	46, **238**
7.	*Avicula* sp.	“ “
7a.	The same, exterior.	
8.	*Pinna* sp.	“ “
9.	*Modiola alabamensis* Ald.	47, **239**
10.	*Arca hatchetigbeensis* n. sp.	“ “
10a.	The same, exterior.	

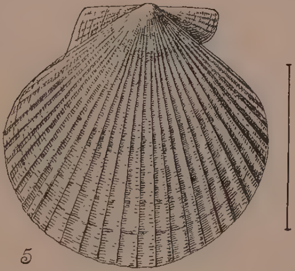
Engraved by the Electro Light Engraving Company, New York.

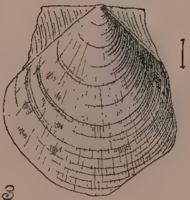

1

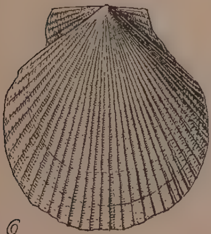

2

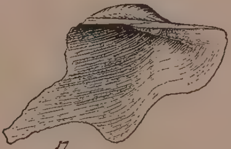

2a

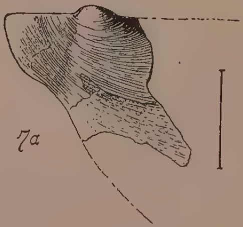

4

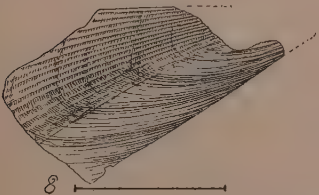

5

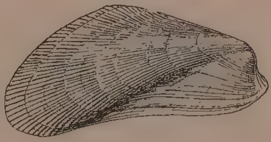

3

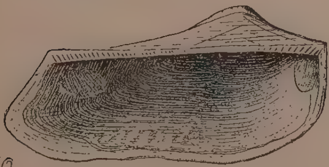

6

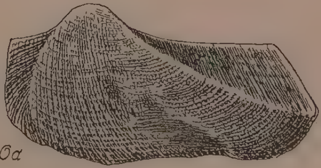

7


7a


8


9


10


10a

(Plate 8).

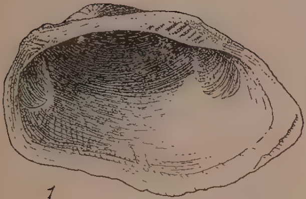
Plate 14.

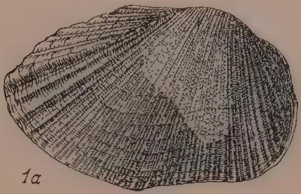
EXPLANATION OF PLATE 8.

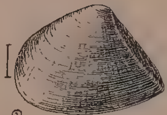
(14)

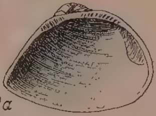
			Page.
Fig.	1.	*Barbatia cuculloides* Con. var	47, **239**
	1a.	The same, exterior.	
	2.	*Trigonarca pulchra* Gabb, var	48, **240**
	2a.	The same, interior.	
	3.	*Cucullæa gigantea* Con., var	49, **241**
	3a.	The same, showing hinge.	
	4.	*C. gigantea* Con., var. Left valve	“ “
	5.	*Pectunculus idoneus* Con., var	“ “
	5a.	The same, interior.	
	6.	*P. idoneus* Con., var	“ “
	7.	*Nucula ovula* Lea	50, **242**
	8.	*Leda elongatoidea* Ald	“ “
	9.	*L. elongatoidea* Ald., var	“ “
	10.	*Leda corpulentoides*	51. **243**
	11.	*Leda corpulentoides*	“ “
	12.	*Leda marieana* Ald	“ “
	13.	*Leda protexta* Con	52, **244**
	14.	*Leda parva* Rogers	53, **245**
	15.	*Yoldia aldrichiana* Har	“ “

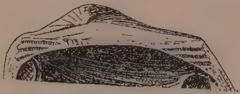
Engraved by the Electro Light Engraving Company, New York.

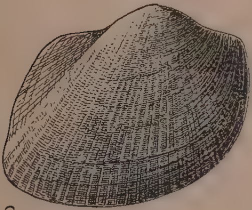

1

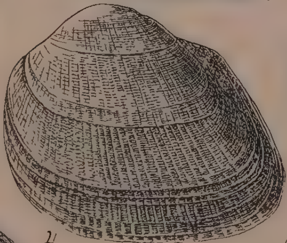

1a

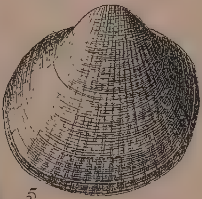

2

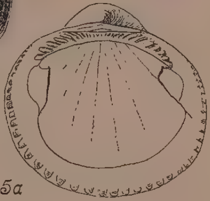

2a

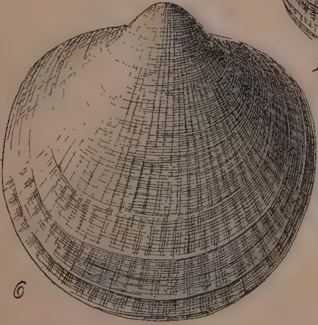

3a

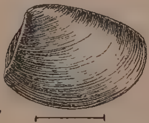

3

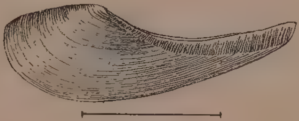

4

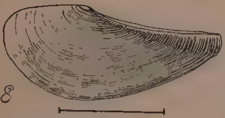

5

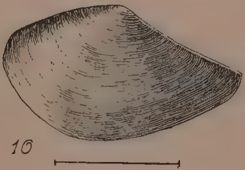

5a

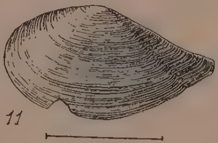

6

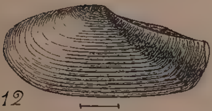

7

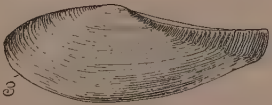

9

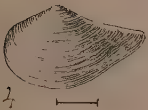

8

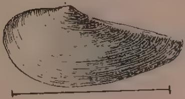

10


11


12


13


14


15

(Plate 9).

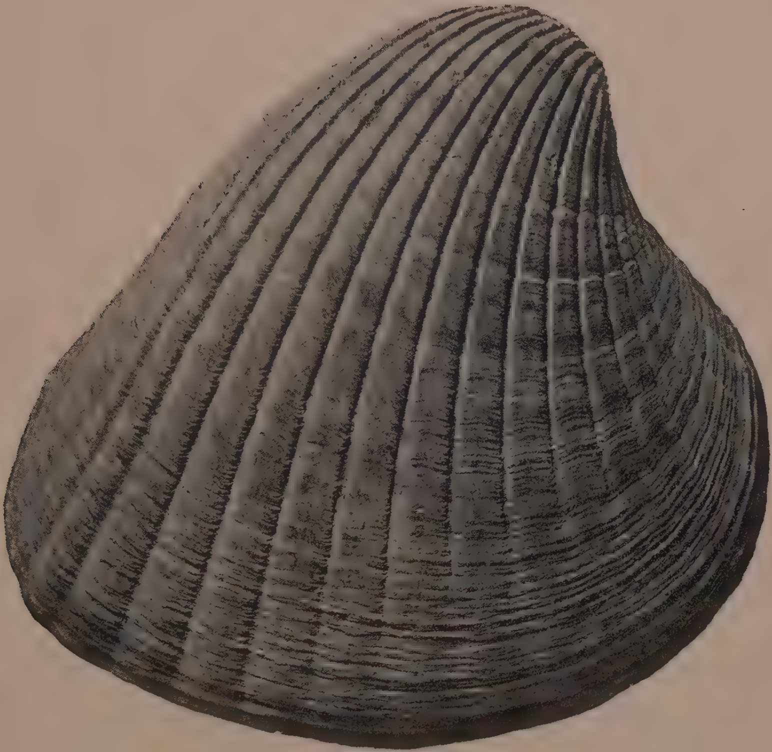
Plate 15.

EXPLANATION OF PLATE 9.

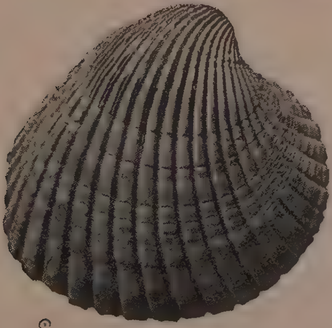
(15)

		Page.
Fig. 1.	*Venericardia planicosta* Lam. A large right valve, nearly life size from Bell's landing; showing nasute posterior.	54, **246**
Fig. 2.	*V. planicosta* Lam. A smaller, younger specimen of this variety from Bell's landing.	" "
Fig. 3.	*V. planicosta* Lam. Young of the variety shown by fig. 5, pl. 10.	" "

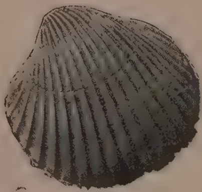
Half-toned by the Albany Engraving Co.



1



2



3

(Plate 10).

Plate 16.

EXPLANATION OF PLATE 10.

(16)

Page.

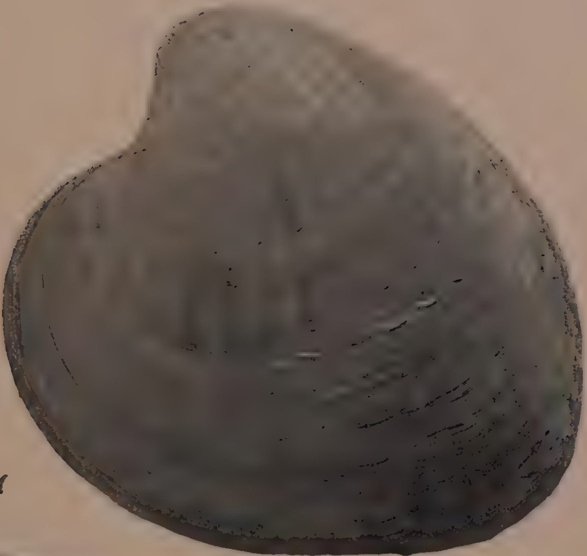
Fig. 1-4. *Venericardia planicosta* Lam........................ 54, **246**

Showing different stages of growth of an upper Lignitic and Lower Claiborne variety; ribs few, distinct, approximate at beak, becoming obsolete on the adult shell. All from Woods bluff.

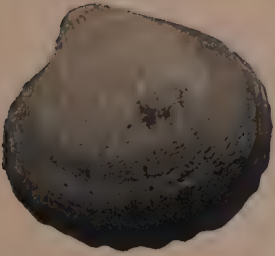
5. *V. planicosta* Lam.................................. " "

A common upper Lignitic and Lower Claiborne variety from Woods bluff.

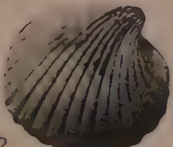
Half-toned by The Albany Engraving Company.



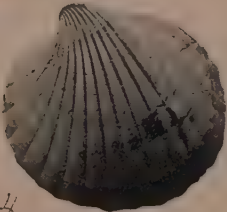
1



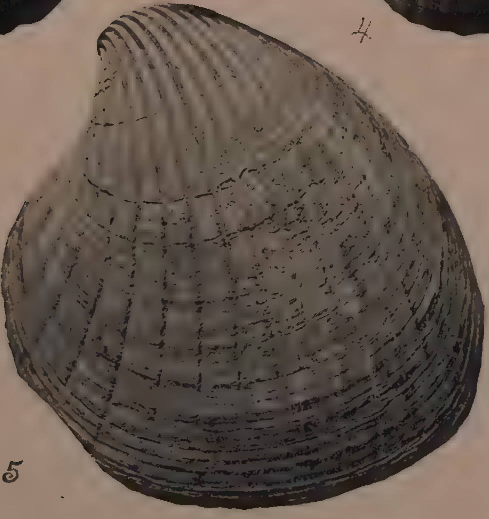
2



3



4



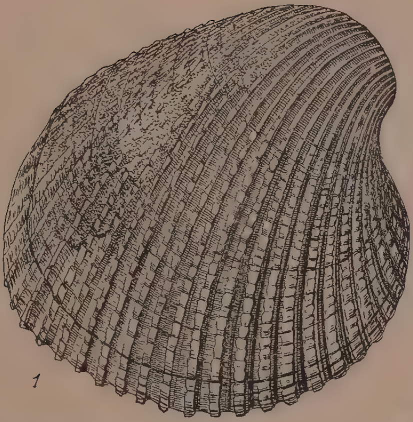
5

EXPLANATION OF PLATE II.

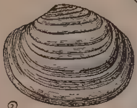
(17)

		Page.
Fig. 1.	*Venericardia alticostata* Con. var.	55, **247**
2.	*Astarte smithvillensis* Har.	56, **248**
3.	*Crassatella tumidula* Whitf.	“ “
4.	*C. tumidula* Whitf. Exterior view.	“ “
5.	*C. halei*, n. sp.	57, **249**
6.	*Kellia prima* Ald.	58, **250**
6a.	The same, interior.	
7.	*Fabella oblonga* Ald.	“ “
8.	*F. oblonga* Ald., exterior	
9.	*Scintilla clarkeana* Ald.	“ “

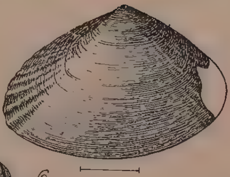
Engraved by the Electro Light Engraving Company, New York.



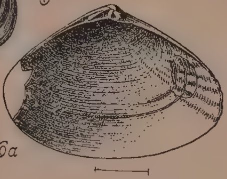
1



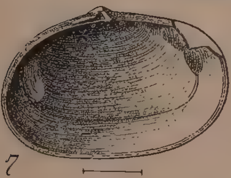
2



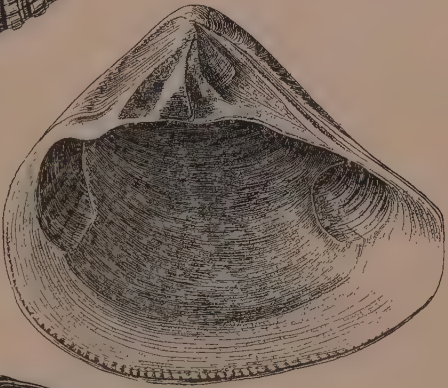
6



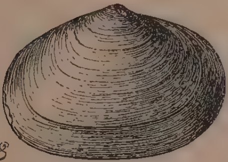
6a



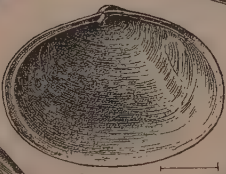
7



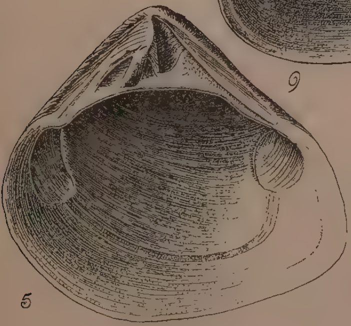
3



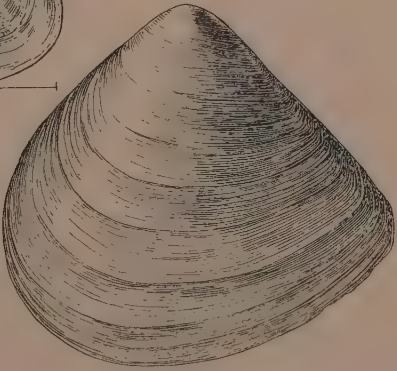
8



9



5



(Plate 12).

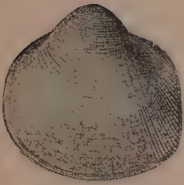
Plate 18.

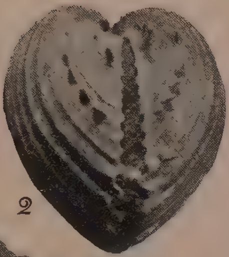
EXPLANATION OF PLATE 12.

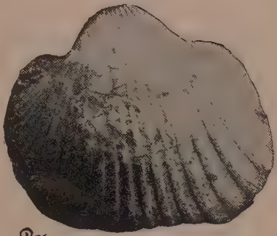
(18)

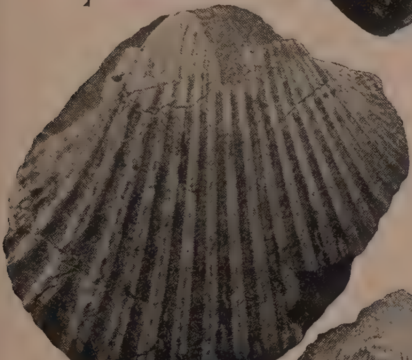
Fig.		Page.
Fig. 1.	*Protocardia lenis* Con. var.	58, **250**
2.	*Cardium hatchetigbeense* Ald. Posterior view; one of Aldrich's types. See Geol. Surv. Ala., Bull. 1, p. 4, fig. 12b.	59, **251**
2a.	*C. hatchetigbeense* Ald. Lateral view; one of Aldrich's types; *l. c.* fig. 12.	“ “
3.	*C. hatchetigbeensis ?* Ald. Large fragmentary specimen from Sabinetown, Texas.	60, **252**
4.	*C. tuomeyi* Ald.	“ “
5.	*Meretrix nuttalliopsis* Heilp.	61, **253**
6.	*M. subimpressa* Con. var.	63, **255**
7.	The same species, interior view.	
8.	*M. nuttalliopsis* var. *fulva*, n. var.	62. **254**
9.	The same species, younger, more pointed.	
10.	The same species, young, broad posteriorly.	
11.	*Meretrix hatchetigbeensis* Ald.	63, **255**
12.	The same species, interior.	
13.	*Dosiniopsis lenticularis* Rogers.	64, **256**
14.	*Psammobia ozarkana*, n. sp. (See pl. 13, fig. 8).	65, **257**
15.	*Tellina trumani*, n. sp. (See pl. 14, fig. 10.).	73, **265**

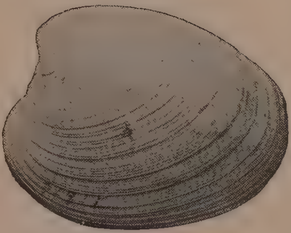
Half-toned directly from the specimens by The Albany Engraving Company.

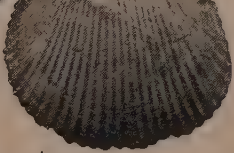

1

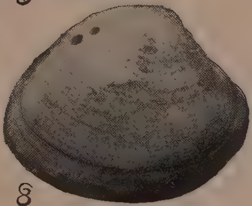

2

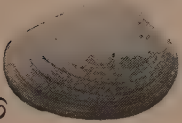

2a

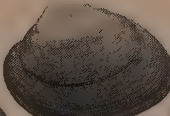

3

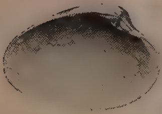

5

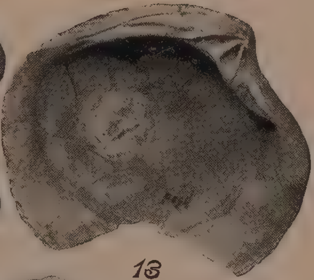

4

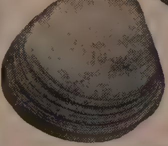

8

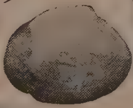

6

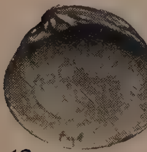

9

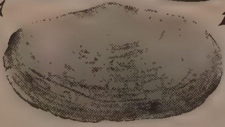

7

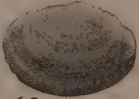

13


11


10


12


14


15

(Plate 13).

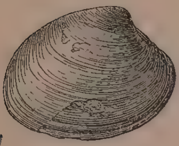
Plate 19.

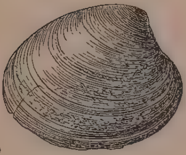
EXPLANATION OF PLATE 13.

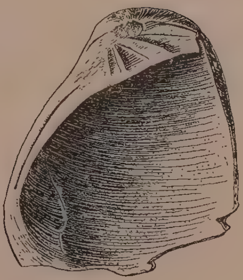
(19)

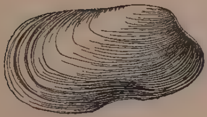
			Page.
Fig.	1.	*Meretrix nuttalliopsis* var. *greggi* n. var. .8 natural size	62, **254**
	2.	*Meretrix nuttalliopsis* var. *greggi* n. var. .8 natural size	" "
	3.	*Corbicula ? cornelliana* n. sp	65, **257**
	4.	*Coralliophaga prima* n. sp	60, **252**
	4a.	Interior of the same.	
	5.	*C. prima* (edentulous)	" "
	6.	*Sphærella*	65, **257**
	7.	*Diplodonta*	" "
	8.	*Psammobia ozarkana* n. sp	" "
	9.	*Solen*	66, **258**
	10.	*Mactra prætenuis* var. *bistriata* n. sp	" "
	11.	*Corbula concha* Ald	" "
	12.	*C. aldrichi* Meyer, left valve, with radii	67, **259**
	13.	*C. aldrichi* Meyer, showing right valve, exterior	" "
	13a.	*C. aldrichi* Meyer, showing right valve, interior	" "
	14.	*Corbula alabamiensis* var.	68, **260**
	14a.	The same, exterior.	
	15,	*Pholas alatoidea*	69, **261**
	15a.	Inside, showing spoon-shape process.	
	16.	*Glycymeris alabama* n. sp. .8 nat. size	" "

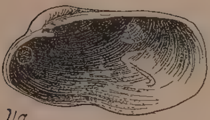
Engraved by the Electro Light Engraving Company, New York.

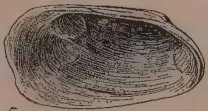

1

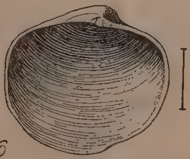

2

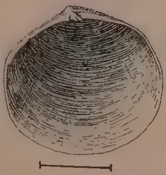

3

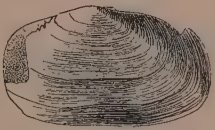

4

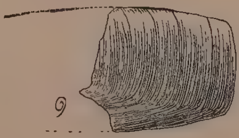

4a

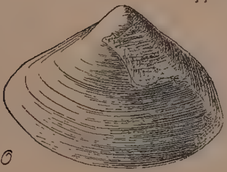

5

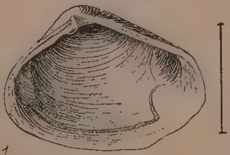

6

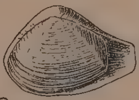

7

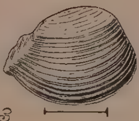

8

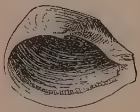

9

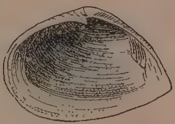

10

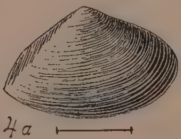

11

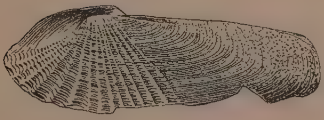

12

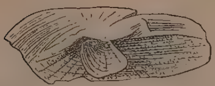

13

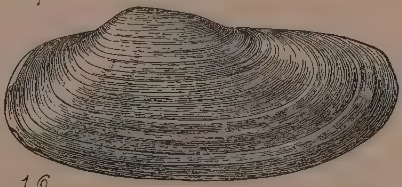

13 a


14


14 a


15


15 a


16

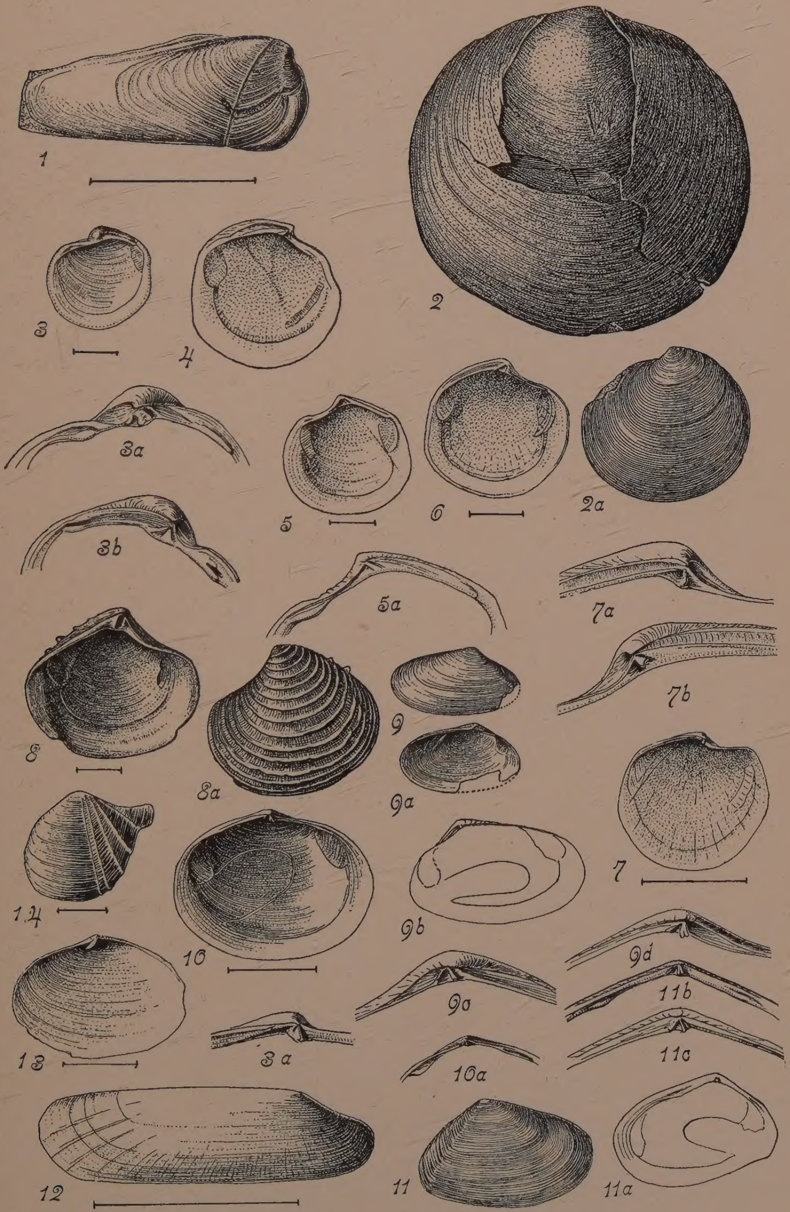
(Plate 14).

Plate 20.

EXPLANATION OF PLATE 14.

(20)

Fig.		Page.
1.	*Martesia elongata* Ald.	69, **261**
2.	*Lucina greggi* Har., .8 nat. size	70, **262**
2a.	*Lucina greggi ?*, young	“ “
3.	*Lucina pomilia* Con., right valve	“ “
3a.	The hinge enlarged.	
3b.	Hinge of the opposite valve enlarged.	
4.	*Lucina symmetrica?*	71, **263**
5.	*Lucina ulrichi* Clark	“ “
5a.	Hinge of the same enlarged.	
6.	*L. ulrichi* Clark, left valve.	
7.	*L. ozarkana*, n. sp.	72, **264**
8.	*L. astartiformis* Ald., interior	“ “
8a.	The same, exterior.	
9.	*Tellina greggi* Har., exterior, .8 nat. size	“ “
9a.	The same, interior.	
9b.	The same; outline showing characteristic features.	
9c.	The same, hinge greatly enlarged.	
9d.	The same, hinge greatly enlarged.	
10.	*Tellina trumani* n. sp.	73, **265**
10a.	Hinge of opposite valve enlarged.	
11.	*Tellina subtriangularis* Ald.	“ “
11a-c.	The same, showing characteristic features.	
12.	*Solemya alabamensis*, n. sp.	“ “
13.	*Periploma butleriana* Ald.	74, **266**
13a.	Enlarged hinge of another specimen from Baker's bluff.	
14.	*Cuspidaria prima* Ald.	“ “


1
2
3
4
3a
5
6
2a
3b
5a
7a
7b
8
8a
9
9a
1.4
10
9b
7
13
9d
9c
11b
3 a
11c
10a
12
11
11a